Monitoring report form for CDM project activity
(Version 08.0)

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	3.4		
Version number of this monitoring report	1		
Completion date of this monitoring report	29/07/2021		
Monitoring period number	Second Monitoring Period		
Duration of this monitoring period	01/01/2018 – 09/07/2021		
Monitoring report number for this monitoring period	NA		
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		
Applied methodologies and standardized baselines	ACM0002 version 14 - Grid-connected electricity generation from renewable sources		
Sectoral scopes	1		
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 until 31 December 2020	Amount achieved from 1 January 2021
	0	62,584	7,700
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	100,701		

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 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 20,582 tCO_2/year or 82,327tCO_2 for this first monitoring report).

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;
- 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.:

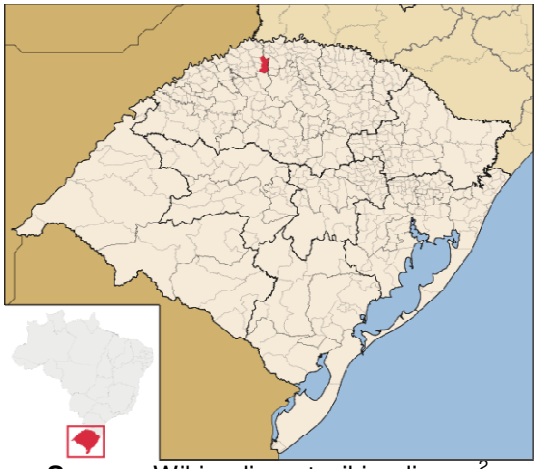
SHP Tambaú	- Erval Seco and Redentora cities
SHP das Pedras	- Água Doce city
SHP Rio do Sapo	- Tangará da Serra city

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[1]

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



Source: Wikipedia - pt.wikipedia.org[2]

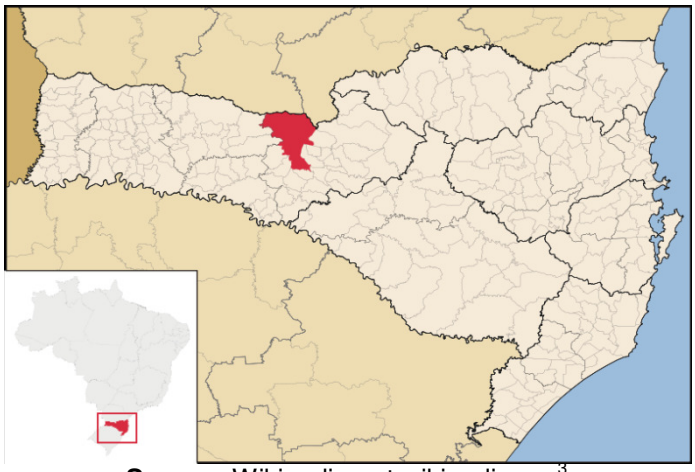
Figure 2: Redentora city localization in Rio Grande do Sul state

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

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

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.

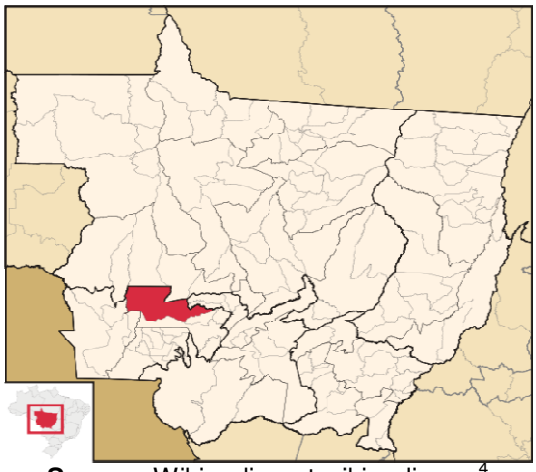


Source: Wikipedia - pt.wikipedia.org[3]

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.



Source: Wikipedia - pt.wikipedia.org[4]

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

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

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

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. References 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 (http://cdm.unfccc.int/methodologies/DB/UB3431UT9I5KN2MUL2FGZXZ6CV71LT).

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.

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 commissioning and also authorization for commercial operation start date is on 28/03/2013 (as per ANEEL Dispatch #916).

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 commercial operation start date was authorized on 23/12/2017 (as per ANEEL Dispatch #4364), but the commissioning conclusion only occurs on 02/01/2018 (as per Eletrisa Commissioning Report).

The **SHP Rio do Sapo** has installed capacity of 5.76 MW and is located on the “do Sapo” river, in Tangará da Serra city, Mato Grosso state. The SHP commissioning and also commercial operation start date is on 27/02/2016 (as per ANEEL Dispatch #500).

Based on the equipments' plaques.

B.2. Post-registration changes

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

PRC-9925-001 valid from 15/03/2019

B.2.2. Corrections

PRC-9925-001 valid from 15/03/2019

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 methodological regulatory documents

PRC-9925-001 valid from 15/03/2019

B.2.6. Changes to project design

Not Applicable

B.2.7. Changes specific to afforestation or reforestation project activity

Not Applicable

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[5], 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;
(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 by a qualified organization that must comply with national standards and industrial regulations to ensure the system accuracy. 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[6].

(2) Emergency treatment

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

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

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[7].

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 $EF_{grid,BM,y}$**:**

The CO_2 emission factors related to estimation ex-ante of GHG reductions of this project activity ($EF_{grid,OM\text{-}DD,y}$ and $EF_{grid,BM,y}$) as mentioned previously, are the values correspondent to the year 2018 until 2021 (made available by the Brazilian DNA). It can be viewed at DNA website (https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/index.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[8], if the present/real installed capacity is greater than +/- 5 % of the authorized

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

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

(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.

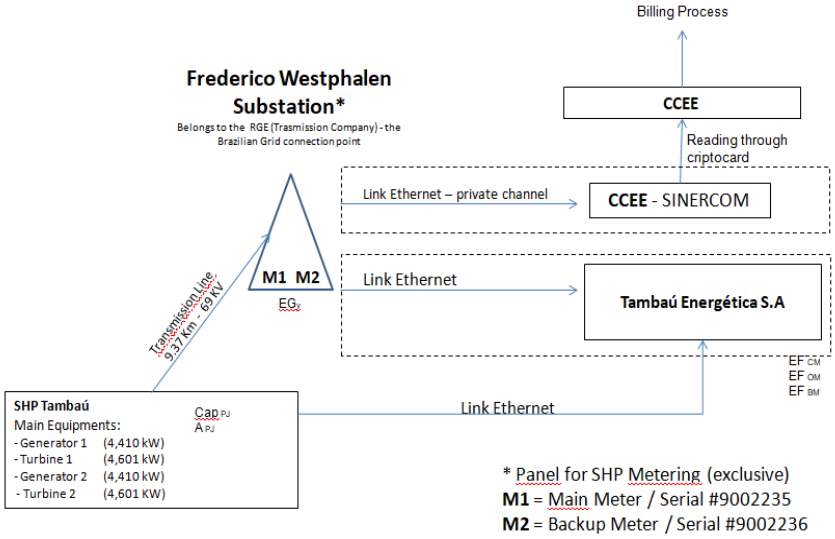
5) Area of the reservoir – A_{PJ}:

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.

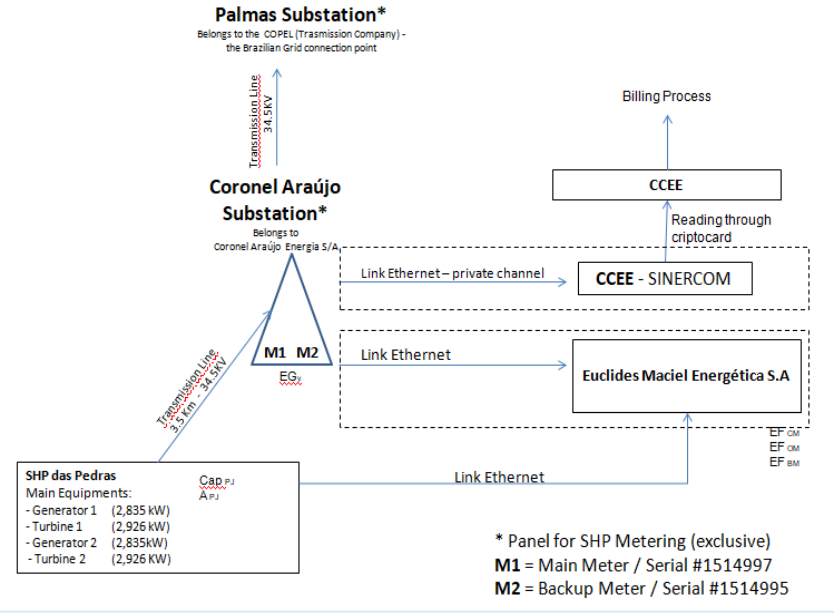
Authority and Responsibility:

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.

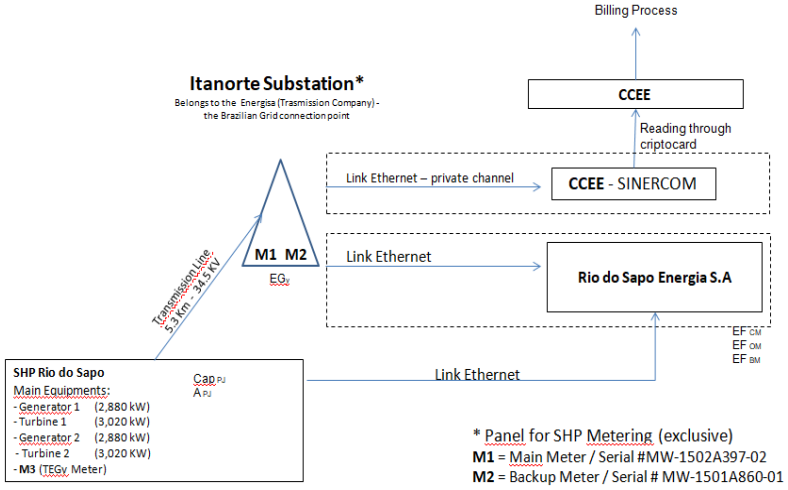
SHP Tambaú – Diagram:



SHP das Pedras – Diagram:



SHP Rio do Sapo – Diagram:



SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	$Cap_{BL(Tambaú,\ das\ Pedras\ and\ Rio\ do\ Sapo)}$
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or measurement methods and procedures	Not applicable.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	

Data/Parameter	$A_{BL(Tambaú, das Pedras and Rio do Sapo)}$
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 (m^2). For new reservoirs, this value is zero.
Source of data	Project site.
Value(s) applied	0
Choice of data or measurement methods and procedures	Not applicable.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	

Data/Parameter	EF_{res}
Unit	kgCO2e/MWh
Description	Default emission factor for emission from reservoirs of hydro power plants.
Source of data	Decision by EB 23, annex 5.
Value(s) applied	90
Choice of data or measurement methods and procedures	Standard value.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	Applicable if the power densities of project activity become greater than 4 W/m2 and less than or equal to 10 W/m2.

D.2. Data and parameters monitored

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	2018 = 46,800.24 2019 = 38,018.40 2020 = 32,720.40 2021 July = 10,930.32
Monitoring equipment	Two meters type Elo model 2180 (one main and one back-up) installed in a metering panel, which is in Frederico Westphalen substation. The main meter has the serial number 9002235. The back-up meter has the serial number 9002236. Both have accuracy class 0.2. Calibrations on 12/05/2016 and 29/01/2020 (valid for 5 years according to ONS procedure submodule 12.3 version 2.0).
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	2018 = 10,862.40 2019 = 19,210.68 2020 = 12,376.66 2021 July = 6,698.64
Monitoring equipment	Two meters type Landis + Gyr E750 (one main and one back-up) installed in a metering panel. The main meter has the serial number 1514997. The back-up meter has the serial number 1514995. Both have accuracy class 0.2 Calibrations on 13/08/2019.
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	Energy Meters (one main and one backup located in a exclusive panel in intersection of the transmission line to Itanorte substation)
Value(s) of monitored parameter	2018 = 22,029.57 2019 = 21,642.30 2020 = 14,506.68 2021 July = 6,746.68

Monitoring equipment	Two meters type ION8650 (one main and one back-up) installed in a metering panel, which is in Itanorte 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. Calibration on 07/02/2017 (valid for 5 years according to ONS procedure submodule 12.3 version 2.0).
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	Energy Meter (located in a panel inside powerhouse)
Value(s) of monitored parameter	2018 = 22,054.10 2019 = 21,675.33 2020 = 14,568.11 2021 July = 6,781.99
Monitoring equipment	Meters SEL300 from SEL with accuracy class 0.1. Serial Numbers: GU1# 2008009126 GU2# 2008009130 Calibration on 01/12/2015 valid for 5 years after 01/01/2017[9]. Exchanged to meter Landis+Gyr E-750 class 0.2 Serial Number # 1518171 Calibration on 26/09/2019 valid for 5 years.
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 that 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

[9] According to ONS submodule 12.3 item 5.1.2.2 from 01/01/2017 the calibration period was changed from 2 to 5 years.

Measured/calculated/ default	Calculated.
Source of data	Based on data provided by the DNA (Designated National Authority).
Value(s) of monitored parameter	2018 = 0.3380 2019 = 0.3100 2020 = 0.2759 2021 (July) = 0.3411
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	2018 = 0.5390 2019 = 0.5181 2020 = 0.4539 2021 (July) = 0.5842
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	-

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	2018 = 0.1370 2019 = 0.1020 2020 = 0.0979 2021 (July) = 0.0979
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	-

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	5,760,000
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	Rischbieter Engenharia e Serviços File: DUP ANEEL_AREASDO ESTADO RS-PLANTA A1_R1.pdf
Value(s) of monitored parameter	188,460
Monitoring equipment	Third party companies 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	*Novo Rumo Topografia* File: *ACAD-NR-A0_BASE TCHE_ FUNDIÃRIO_SAD69_OFICIAL31_07_2017l-Layout1.pdf*
Value(s) of monitored parameter	474,200
Monitoring equipment	Third party companies 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	*Meditec Topografia* *File: Área do RES_APP - PCH RIO DO SAPO-Model.pdf*
Value(s) of monitored parameter	1,006,500
Monitoring equipment	Third party companies 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 MR2_rev1.xls", tabs "2018", "2019" "2020", "2021".

Below, follow a summary of $EF_{grid,OM,y}$:

$EF_{grid,OM,2018}$ (tCO_2/MWh)	0.5390
$EF_{grid,OM,2019}$ (tCO_2/MWh)	0.5181
$EF_{grid,OM,2020}$ (tCO_2/MWh)	0.4539
$EF_{grid,OM,2021}$ (tCO_2/MWh)	0.5842

"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[10]. The last available data is for 2020 year.

$EF_{grid,BM,2018}$ = 0.1370 tCO_2/MWh

$EF_{grid,BM,2019}$ = 01020 tCO_2/MWh

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

$EF_{grid,BM,2020}$= 0.0979 tCO_2/MWh

$EF_{grid,BM,2021}$ = 0.0979 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:

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

Year	$EF_{grid,OM,y}$ (tCO_2/MWh)	$EF_{grid,BM,y}$ (tCO_2/MWh)	$EF_{grid,CM,y}$ (tCO_2/MWh)
2018	0.5390	0.1370	0.3380
2019	0.5181	0.1020	0.3100
2020	0.4539	0.0979	0.2759
2021	0.5842	0.0979	0.3411

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

The PD = 8,820,000 / 188,460 = 46.80 W/m^2
So, since the PD is above 10 W/m^2:

***PEy* =0**

SHP das Pedras

The PD = 5,670,000 / 46,600 = 12.30 W/m^2
So, since the PD is above 10 W/m^2:

SHP Rio do Sapo

Details about *PEy* calculation on Section E.2.

For 2018
PE_{2018} = 1,985

For 2019
PE_{2019} = 1,951

For 2020
***PE*$_{2020}$ = 1,311**

For 2021
***PE*$_{2021}$ = 610**

So

ER = BE$_y$, for SHP Tambaú and SHP das Pedras and
ER = BE$_y$ - PEy , 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).

$$BE_y = EF_{grid,CM,y} \cdot EG_y$$

Then:

SHP Tambaú	$EF_{grid,CM,y}$ (tCO_2/MWh)	EG_y (MWh)	BE_y (tCO_2e)
2018	0.3380	46,800.24	15,819
2019	0.3100	38,018.40	11,787
2020	0.2759	32,720.40	9,027
2021	0.3411	10,930.32	3,727

SHP das Pedras	$EF_{grid,CM,y}$ (tCO_2/MWh)	EG_y (MWh)	BE_y (tCO_2e)
2018	0.3380	10,862.40	3,671
2019	0.3100	19,210.68	5,956
2020	0.2759	12,376.66	3,414
2021	0.3411	6,698.64	2,284

SHP Rio do Sapo	$EF_{grid,CM,y}$ (tCO_2/MWh)	EG_y (MWh)	BE_y (tCO_2e)
2018	0.3380	22,029.57	7,446
2019	0.3100	21,642.30	6,710
2020	0.2759	14,506.68	4,002
2021	0.3411	6,746.68	2,300

$ER_{Rio\ do\ Sapo,\ 2018}$ = 7,466 - 1,985 = 5,461 tCO_2e
$ER_{Rio\ do\ Sapo,\ 2019}$ = 6,710 - 1,951 = 4,759 tCO_2e
$ER_{Rio\ do\ Sapo,\ 2020}$ = 4,002 - 1,311 = 2,690 tCO_2e
$ER_{Rio\ do\ Sapo,\ 2021}$ = 2,300 - 610 = 1,689 tCO_2e

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 2018
PE_{2018} = 22,054.10 . 90/1000
PE_{2018} = 1,985

For 2019
PE_{2019} = 21,675.33. 90/1000
PE_{2019} = 1,951

For 2020
PE_{2020} = 14,568.11. 90/1000
PE_{2020} = 1,311

For 2021
PE_{2021} = 6,781.99. 90/1000
PE_{2021} = 610

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 until 31/12/ 2020	From 01/01/ 2021	Total amount
Total	76,143	5,857	0	0	62,584	7,700	70,284

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 for this monitoring period in the PDD (t CO_2e)
70,284	100,701

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

The amount estimated ex ante is the same described on registered PDD (100,701 tCO2e).

E.6. Remarks on increase in achieved emission reductions

Not applicable

E.7. Remarks on scale of small-scale project activity

Not applicable

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Document information

Version	*Date*	*Description*
08.0	6 April 2021	Revision to: • Reflect the "Clarification: Regulatory requirements under temporary measures for post-2020 cases" (CDM-EB109-A01-CLAR).
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
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.

Version	*Date*	*Description*
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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