Monitoring report form for CDM project activity (Version 09.0)

MONITORING REPORT			
Title of the project activity	Rondinha Small Hydroelectric Power Plant		
UNFCCC reference number of the project activity	10080		
Version number of the PDD applicable to this monitoring report	10		
Version number of this monitoring report	1		
Completion date of this monitoring report	15/09/2022		
Monitoring period number	First Monitoring Period		
Duration of this monitoring period	01/01/2015 – 31/12/2021		
Monitoring report number for this monitoring period	Not applicable		
Project participants	Rondinha Energética S.A.		
Host Party	Brazil		
Applied methodologies and standardized baselines	Approved consolidated baseline and monitoring methodology ACM0002, version 14.0 - "Grid-connected electricity generation from renewable sources".		
Sectoral scopes	01		
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	80,606	9,128
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	71,666		

SECTION A. Description of project activity

A.1. General description of project activity

Rondinha Small Hydroelectric Plant CDM Project, hereinafter referred to as Rondinha Project, consists of small run-of-river power plant with 9.5994[1] MW installed capacity and a reservoir area of 0.62 km^2 which supplies clean electricity to the Brazilian National Interconnected System (Sistema Interligado Nacional - SIN).

The project activity consists in a Small Hydroelectric Power Plant (SHPP) that is located in the Chapecó River, part of the Uruguai River Basin, at the municipality of Passos Maia, which is part of the Santa Catarina State in Brazil.

The baseline scenario, defined by ACM0002 methodology (version 14.0), is the same scenario existing before the implementation of the project activity, which is: the electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the Combined Margin (CM) emission factor calculations described in "TOOL07: Tool to calculate the emission factor for an electricity system".

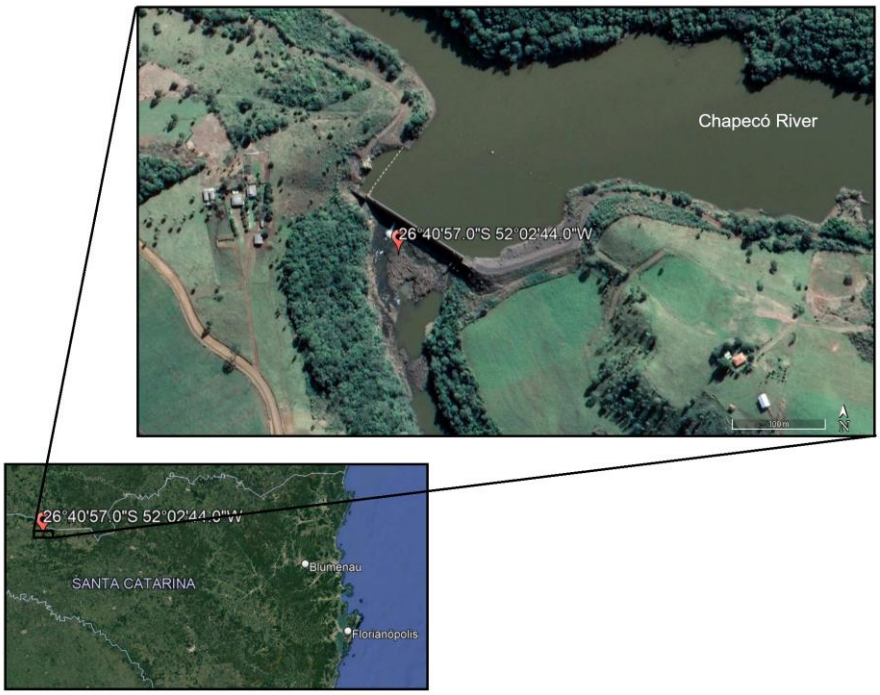
The emission reduction achieved during this monitoring period was 89,734 tCO_2e.

A.2. Location of project activity

Rondinha project is located in Passos Maia City, Santa Catarina State in the south region of Brazil. The exact location of the project is 26° 40' 57" South and 52º 02' 44" West (GPS Coordinates). This localization is supported by the LAI Nº 22/2009 (Installation License delivered by FATMA). Figure 01 below shows the exact location of the plant.

[1] All environmental licenses and permits issued by regulators in Brazil refer to an installed capacity of 9.6 MW, as the original registered PDD (which is an rounded value of 9.5994 MW). However, considering the capacity of generators and its load factor, the exact installed capacity of the plant is 9.5994 MW. A Post Registration Change was carried out to show the exact installed capacity of the plant. This change does not affect addionality analysis which considered the rounded value.

Figure 01 – Location of Rondinha Small Hydroelectric Plant



A.3. Parties and project participants

Table 2 – Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host Party)	Private Entity: Rondinha Energética S.A.	No

A.4. References to applied methodologies and standardized baselines

- Large-scale consolidated methodology ACM0002, version 14.0 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".[2]
- TOOL01: Tool for the Demonstration and Assessment of Additionality, version 7.0.0[3].
- TOOL07: Tool to calculate the emission factor for an electricity system, version 04.0[4].

[2] https://cdm.unfccc.int/filestorage/A/0/4/A04BWNRKLUEP6O1QX75YVTH28JDICZ/EB%2075_repan13_ACM0002_ver%2014.0.pdf?t=R1R8cmk1dHFyfDBjFps7q1yfzn_n4v1QYfkg

[3] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf

[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf

A.5. Crediting period type and duration

The project activity uses renewable crediting period, and the duration is from 01/01/2015 to 31/12/2021.

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

In 18/12/2014, Rondinha SHPP was registered by CDM EB[5] as a CDM Project. In 13/02/2023, Post Registration Change was approved by Executive Board[6]

The project activity generates electricity by a greenfield run-of-river small hydroelectric power plant, a technology that has the minimum impact on the environment, since the reservoir was designed with a storage capacity of one day of electricity generation. The project uses Kaplan turbines, which are a widely used technology. The following table presents the main technical parameters of the project activity.

Table 3 – Main technical characteristics of Rondinha

Parameter	Technical Characteristics
Installed Capacity	9.5994 MW
Capacity Factor (Plant Load Factor)	61.24%
Estimated average net electricity generation (MWh)	51,500 MWh
Turbines	2 Kaplan - Horizontal Axis – 5.410 MW each and 400rpm
Generators	2 synchronic generators, 5,333 kVA each – rated voltage 13.8 kV with Capacity Factor of 0.9

The main milestones of project implementation are presented at the following table:

Table 4 – Main Milestones of Project Implementation

Date (dd/mm/yyyy)	Milestone
02/10/2009	Installation License Issuance by FATMA
19/05/2010	4 PPA's signed with Tramontina's group subsidiaries (Start Date) (Investment Decision Date)
27/04/2011	Request for financing BNDES (Letter sent to BRDE Bank)
15/06/2011	Contract to acquire the Turbines, Generators and all the related equipment signed

[5] https://cdm.unfccc.int/Projects/DB/DNV-CUK1418833982.52/view

[6] PRC : https://cdm.unfccc.int/PRCContainer/DB/prcp44225895/view

Date (dd/mm/yyyy)	Milestone
02/12/2013	First Operational License Issuance by FATMA
16/04/2014	ANEEL authorizes test operation through Dispatch 1,226.
03/06/2014	ANEEL authorizes commercial operation through Dispatch 1,709.

B.2. Post-registration changes

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

There are no deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents.

B.2.2. Corrections

There are no corrections to project information or parameters fixed at the registration of the project activity.

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

There are no changes to the start date of the crediting period.

B.2.4. Inclusion of monitoring plan

There are no post-registration changes to include a monitoring plan into the PDD.

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

There are no permanent changes to the registered monitoring plan, or permanent deviation of monitoring from applied methodologies, applies standardized baselines, or other methodological regulatory documents.

B.2.6. Changes to project design

In 13/02/2023, CDM Executive Board approved through PRC-10080-001[7] permanent changes to project design.

The following changes were approved:

Permanent Changes to the Project Design

Letter "H" of item 241 of the CDM p**roject standard for project activities:**

"Actual operational parameters that are within the control of the project participants, differing from the expected parameters";

[7] https://cdm.unfccc.int/PRCContainer/DB/prcp44225895/view

1. The turbines implemented by the project activity have different capacity (5.410 MW) from the predicted in the registered PDD (4.990 MW). This change did not impact the installed capacity of the plant and the electricity supply to the grid estimation, which is defined by generators capacity.
2. The registered PDD stated that the generators have 5.333 kVA of installed capacity each, with load factor of 0.9. Using these values, the registered PDD considered the installed capacity of the plant as 9.6 MW which is a rounded value for 9.5994 MW which is obtained if the load factor is applied to the capacity of the generators. The rounded value of 9.6 MW is the official installed capacity value considered by regulators and authorities in Brazil for the plant. All environmental licenses, sectorial authorizations and permits refer to and installed capacity of 9.6 MW. Brazilian Regulators do not consider this immaterial variation a change in the installed capacity. However, to use the exact value of the installed capacity of the plant, as CDM definition, the registered PDD was updated, using the value of 9.5994 MW as installed capacity of the plant. No additional investment was performed, and these changes do not affect the revenues potential of the plant. Therefore, additionality analysis was not affected.
3. The area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full reservoir area (A_{PJ}) is a parameter to be monitored. The operation license of the plant 3370/2018 showed that the reservoir area implemented differs from information presented at the PDD registered. A_{PJ} of Rondinha SHP is 620,000. This value was also updated in the PDD.
4. Changes of item 2 and 3 impacted power density result which was also updated.

This monitoring report already considered changes approved by PRC-10080-001.

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

Not applicable. This CDM project is not an afforestation or reforestation project activity.

SECTION C. Description of monitoring system

The Monitoring Plan is elaborated according to the Monitoring Methodology presented in the consolidated baseline methodology for grid-connected electricity generation from renewable sources ACM0002, version 14.0.

The monitoring system predicts to monitor the following parameters:

- Quantity of net electricity generation supplied by the project plants to the grid in year *y (*EGfacility,y);
- Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (*EFgrid,CM,y)*
- Operating margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (*EFgrid,OM,y)*
- Build margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system” (*EFgrid,BM,y)*
- Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ})
- Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ})

EGfacility,y

As defined in the registered PDD, the power plant has two billing meters, a main one and other one as backup, for reading and keeping record of the electricity generation. Both meters operate in parallel and with the same functional characteristics. In case of failure, the remaining one will be operative. These meters are located at Palmas substation.

$EG_{facility,y}$ found in the meter was compared to CCEE data. The minor data between them was used to calculate emission reductions achieved by the project.

The calibration of the meters is performed according to the procedure stated by the ONS and according to the maintenance guidelines of the equipment. The periodicity for meter's calibration follows the "ONS Grid Procedures". Until December/2016, the calibration frequency was a maximum of two years. In December/2016, ONS Sub-module 12.3 was updated and it established that meter's calibration should happen each 5 (five) years. Therefore, from the starting date of the first crediting period until 31/12/2016, meters calibration should happen each 2 (two) years and from 01/01/2017, each 5 (five years).

The following calibration happened during this monitored period:

2013

Serial Number: 1157069

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 28/10/2013 (dd/mm/yyyy)

Calibration Validity according to ONS: 27/10/2015

Rear Meter

Serial Number: 1157070

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 28/10/2013 (dd/mm/yyyy)

Calibration Validity according to ONS: 27/10/2015

2016

Principal Meter

Serial Number: 1157069

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 11/10/2016

Calibration Validity according to ONS: 10/10/2021

Rear Meter

Serial Number: 1157070

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 11/10/2016

Calibration Validity according to ONS: 10/10/2021

2021

Principal Meter

Serial Number: 1157069

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 11/11/2021

Calibration Validity according to ONS: 10/11/2026.

2021

Rear Meter

Serial Number: 1157070

Model: E750

Accuracy Class: D (0.2%)

Calibration date: 11/11/2021

Calibration Validity according to ONS: 10/11/2026.

Meters should had been calibrated until 27/10/2015. However, it was just calibrated in 11/10/2016. Following CDM Validation and Verification Standard, paragraph 366, 2016 calibration certificate results present an error below 0.2%, the maximum permissible error. Thus, conservativelly 0.2% error was applied to meter data between from 28/10/2015 to 10/10/2016.

Parameters *EFgrid,CM,y; EFgrid,OM,y and EFgrid,BM,y*

Parameters EFgrid,OM,y and EFgrid,BM,y are calculated by Brazilian DNA using the latest version of the Tool to calculate the emission factor for an electricity system. EFgrid,CM,y; is calculated using equations provided by registered PDD.

Parameter Cap_{PJ}

As indicated by registered PDD, manufacturer technical data and specifications are the evidence for Installed capacity of the hydro power plant after the implementation of the project activity. Besides that, the Environmental Operational License of the project and ANEEL official documents confirm the installed capacity of 9.6 MW (rounded value of 9.5994 MW).

Parameter A_{PJ}

The area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full is verified by environmental entity responsible for environmental licensing. It can be attested by operational environmental license.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	EF_{Res}
Unit	kgCO2e/MWh
Description	Default emission factor for emissions from reservoirs
Source of data	Decision by EB23
Value(s) applied	90
Choice of data or measurement methods and procedures	The methodology states that this value shall be applied for emissions from water reservoirs of hydropower plants.
Purpose of data/parameter	Calculate project emissions from reservoir
Additional comments	No additional comments

Data/Parameter	Cap_{BL}
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	Rondinha Small Hydroelectric Power Plant site
Value(s) applied	0
Choice of data or measurement methods and procedures	Determines the installed capacity based on recognized standards. Rondinha is a new hydro power plant, therefore, as per methodology, this value is zero
Purpose of data/parameter	Calculate project emissions from reservoir
Additional comments	No additional comments

Data/Parameter	**A_{BL}**
Unit	M^2
Description	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m2). For new reservoirs, this value is zero.
Source of data	Rondinha Small Hydroelectric Power Plant site
Value(s) applied	0
Choice of data or measurement methods and procedures	Measured from topographical surveys, maps, satellite pictures, etc. The project activity will produce a new reservoir of 0.76 km2, therefore this value is zero.
Purpose of data/parameter	Calculate project emissions from reservoir
Additional comments	No additional comments

D.2. Data and parameters monitored

Data/Parameter	$EG_{facility,y}$
Unit	MWh/yr
Description	Quantity of net electricity generation supplied by the project plants to the grid in year *y*
Measured/calculated/ default	Measured
Source of data	Project activity site, electricity meters
Value(s) of monitored parameter	2015: 52,208 MWh 2016: 46,171 MWh 2017: 32,594 MWh 2018: 36,552 MWh 2019: 38,579 MWh 2020: 26,630 MWh 2021: 27,978 MWh

Monitoring equipment	There are two meters (one principal and one rear) located at the Palmas substation that measure EGfacility,y. Meters have the following characteristics: **Principal Meter** Serial Number: 1157069 Model: E750 Accuracy Class: D (0.2%) **Rear Meter** Serial Number: 1157070 Model: E750 Accuracy Class: D (0.2%) Meters calibrations follow ONS grid procedures. Until 16/12/2016, ONS used to require calibration each two years. From this date, ONS started to request calibration each five years. Meters were calibrated three times during this monitoring period. **2013** Principal Meter Meter Serial Number: 1157069. Calibration Date: 28/10/2013. Calibration Validity according to ONS: 27/10/2015 Rear Meter Meter Serial Number: 1157070. Calibration Date: 28/10/2013. Calibration Validity according to ONS: 27/10/2015. **2016** Principal Meter Meter Serial Number: 1157069. Calibration Date: 11/10/2016. Calibration Validity according to ONS: 10/10/2021 Rear Meter Meter Serial Number: 1157070. Calibration Date: 11/10/2016. Calibration Validity according to ONS: 10/10/2021. **2021** Principal Meter Meter Serial Number: 1157069. Calibration Date: 11/11/2021. Calibration Validity according to ONS: 10/11/2026. Rear Meter Meter Serial Number: 1157070. Calibration Date: 11/11/2021. Calibration Validity according to ONS: 10/11/2026.
Measuring/reading/recording frequency	Continuous monitoring, monthly recording.

Calculation method (if applicable)	It is a measured data.
QA/QC procedures	Data of $EG_{facility,y}$ is monitored by project participants and counter-checked with spreadsheets provided by CCEE, entity responsible for electricity contracts settlement in Brazil. The minor data between meter data and CCEE data was used to calculate emission reductions achieved by the project.
Purpose of data/parameter	Baseline emissions calculation
Additional comments	Discount in $EG_{facility,y}$ parameter was applied for the uncovered period by calibrations based on the highest value between the last calibration results and the maximum permissible error of equipment was applied. A conservative approach was used. The maximum permissible error was applied from 28/10/2015 to 10/10/2016 to meter data once the maximum permissible error is higher than the errors identified in the delayed calibration test (2016).

Data/Parameter	**$EF_{grid,CM,y}$**
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system".
Measured/calculated/ default	Calculated
Source of data	Calculated by project participants using the latest version of the "Tool to calculate the emission factor for an electricity system" and hourly $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ published by Brazilian DNA.
Value(s) of monitored parameter	2015: 0.4075 tCO_2/MWh 2016: 0.3904 tCO_2/MWh 2017: 0.2955 tCO_2/MWh 2018:0.3380 tCO_2/MWh 2019:0.3100 tCO_2/MWh 2020:0.2759 tCO_2/MWh 2021: 0.3263 tCO_2/MWh
Monitoring equipment	Not applicable. CO_2 emission factor of the grid electricity in year y is calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" and values of EFgrid,OM,y and EFgrid,BM,y published by Brazilian DNA
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	As described in the most recent version of the "Tool to calculate the emission factor for an electricity system". The combined margin emission factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM}$ **Equation 01** Where: $EF_{grid,BM,y}$ = Build margin CO2 emission factor in year y (tCO_2/ MWh) $EF_{grid,OM,y}$ = Operating margin CO2 emission factor in year y (tCO2/ MWh) W_{OM} = Weighting of operating margin emissions factor (%) W_{BM} = Weighting of build margin emissions factor (%) $EF_{grid,BM,y}$ and $EF_{grid,OM,y}$ are calculated and provided by Brazilian DNA. For the first crediting period of hydro power plants projects: W_{OM} = 0.50 and W_{BM} = 0.50, as recommended by the "Tool to calculate the emission factor for an electricity system".

QA/QC procedures	As described in the most recent version of the “Tool to calculate the emission factor for an electricity system”. The uncertainty level for these data is low
Purpose of data/parameter	Baseline emissions calculation
Additional comments	No additional comments

Data/Parameter	**$EF_{grid,OM,y}$**
Unit	tCO_2/MWh
Description	Operating margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Measured/calculated/ default	Calculated
Source of data	Data supplied by Brazilian DNA
Value(s) of monitored parameter	2015: 0.5597 tCO_2/MWh 2016: 0.6228 tCO_2/MWh 2017: 0.5882 tCO_2/MWh 2018:0.5390 tCO_2/MWh 2019:0.5181 tCO_2/MWh 2020:0.4539 tCO_2/MWh 2021: 0.5985 tCO_2/MWh
Monitoring equipment	Not applicable. $EF_{grid,OM,y}$ is calculated by Brazilian DNA using the latest version of the “Tool to calculate the emission factor for an electricity system”.
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	The operating margin emission factor is calculated by Brazilian DNA using the latest version of the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures	As described in the most recent version of the “Tool to calculate the emission factor for an electricity system”. The uncertainty level for these data is low
Purpose of data/parameter	Baseline emissions calculation
Additional comments	No additional comments

Data/Parameter	**$EF_{grid,BM,y}$**
Unit	tCO_2/MWh
Description	Build margin CO2 emission factor for grid connected power generation in year *y* calculated using the latest version of the “Tool to calculate the emission factor for an electricity system”
Measured/calculated/ default	Calculated
Source of data	Data supplied by Brazilian DNA
Value(s) of monitored parameter	2015: 0.2553 tCO_2/MWh 2016: 0.1581 tCO_2/MWh 2017: 0.0028 tCO_2/MWh 2018: 0.1370 tCO_2/MWh 2019: 0.1020 tCO_2/MWh 2020: 0.0979 tCO_2/MWh 2021: 0.0540 tCO2/MWh
Monitoring equipment	Not applicable. $EF_{grid,BM,y}$ is calculated by Brazilian DNA using the latest version of the “Tool to calculate the emission factor for an electricity system”.
Measuring/reading/recording frequency	Annually.

Calculation method (if applicable)	The build margin emission factor is calculated by Brazilian DNA using the latest version of the “Tool to calculate the emission factor for an electricity system”.
QA/QC procedures	As described in the most recent version of the “Tool to calculate the emission factor for an electricity system”. The uncertainty level for these data is low
Purpose of data/parameter	Baseline emissions calculation
Additional comments	No additional comments

Data/Parameter	**CAP_{PJ}**
Unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/calculated/ default	Calculated
Source of data	Project activity site
Value(s) of monitored parameter	9,599,400
Monitoring equipment	Manufacturer technical data (installed/rated capacity of the generator)
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	Based on recognized standards It can be cross checked with environmental licenses and ANEEL authorizations.
Purpose of data/parameter	Baseline emissions calculation
Additional comments	No additional comments

Data/Parameter	**A_{PJ}**
Unit	m^2
Description	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Measured
Source of data	Measured from topographical surveys, maps, satellite pictures, etc. This value is evidenced by environmental operational licenses.
Value(s) of monitored parameter	During all years of the monitoring period, the value of this parameter is 620,000 m^2.
Monitoring equipment	Manufacturer technical data
Measuring/reading/recording frequency	Annually.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	Based on recognized standards. It can be cross checked with environmental operational licenses.
Purpose of data/parameter	Baseline emissions calculation
Additional comments	No additional comments

D.3. Implementation of sampling plan

Not applicable. No sampling plan is implemented.

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

The baseline methodology ACM0002, version 14.0, includes only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. It assumes that all project electricity generation above baseline levels would have been generated by existing grid-connected power plants and the addition of new grid-connected power plants.

The baseline emission is calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y} \quad \textbf{Equation 02}$$

Where:
BE_y = Baseline emissions in year *y* (tCO_2/yr);
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr);
$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the latest version of the *"Tool to calculate the emission factor for an electricity system"*. (tCO_2/MWh).

If the project activity is the installation of a new grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield renewable energy power plants), then:

$$EG_{PJ,y} = EG_{facility,y} \quad \textbf{Equation 03}$$

Where:
$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr);

To calculate $EF_{grid,CM,y}$, it was used data supplied by Brazilian Designated National Authority (DNA), which publishes Dispatch Data Analysis Operating Margin Emission Factor ($OM_{Grid,y}$) and the Build Margin Emission Factor ($BM_{Grid,y}$) using the tool to calculate the emission factor for an electricity system.

The combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \quad \textbf{Equation 01}$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/ MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/ MWh)
W_{OM} = Weighting of operating margin emissions factor (%)
W_{BM} = Weighting of build margin emissions factor (%)

For hydro power generation project activities, W_{OM} = 0.50 and W_{BM} = 0.50 shall be used for the first crediting period. Table below presents the parameters used to calculate baseline emissions and the results per year.

Table 5: Baseline Emissions (tCO_2e)

Years	EGFacility,y (MWh)	$Ef_{grid,OM,Y}$ (tCO_2e/MWh)	$Ef_{grid,BM,y}$ (tCO_2e/MWh)	W_{OM} (%)	W_{BM} (%)	$EF_{grid,CM,y}$ (tCO_2e/MWh)	Baseline Emissions (BE,y) (tCO_2e)
2015	52,208	0.5597	0.2553	50%	50%	0.4075	21,273
2016	46,171	0.6228	0.1581	50%	50%	0.3904	18,027
2017	32,594	0.5882	0.0028	50%	50%	0.2955	9,631
2018	36,552	0.5390	0.1370	50%	50%	0.3380	12,355
2019	38,579	0.5181	0.1020	50%	50%	0.3100	11,961
2020	23,630	0.4539	0.0979	50%	50%	0.2759	6,519
2021	27,978	0.5985	0.0540	50%	50%	0.3263	9,128
Total	**260,760**						**89,734**

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

According to the methodology adopted, the project activity may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \qquad \textbf{Equation 04}$$

Where:
PE_y = Project emissions in year *y* (tCO_2e/yr)
$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO_2/yr)
$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO_2e/yr)
$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO_2e/yr).

Project emissions from fossil fuel consumption in year y (tCO_2/yr)

The project activity consists no fossil fuel consumption, *$PE_{FF,y}$ = 0 tCO_2/year*

Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year y (tCO_2e/yr)

The project activity consists no operation of geothermal power plants, *$PE_{GP,y}$ = 0 tCO_2/year.*

Emissions from water reservoirs of hydro power plants (PEHP,y)

Operation license shows that reservoir area is 0.62 km_2. Project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

(a) If the power density of the project activity (*PD*) is greater than 4 W/m2 and less than or equal to 10 W/m2:

$$\mathrm{PE}_{\mathrm{HP,y}} = \frac{EF_{\mathrm{Res}} \cdot TEG_y}{1000} \qquad \textbf{Equation 05}$$

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 ($kgCO_2e/MWh$)
TEGy = 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 the power density of the project activity (*PD*) is greater than 10 W/m_2:

$$PE_{HP,y} = 0$$

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$

Equation 06

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) (9,599,400 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 (0 W)
A_{PJ} = Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m_2) (620,000 m^2)
A_{BL} = 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 (0 m^2)

PD = 9,600,000 / 620,000 = 15,48 W/m^2

Since the power density of the Rondinha Small Hydroelectric Power Plant is 15.48 W/m^2, greater than 10 W/m_2, according to the methodology, there are no project emissions.

E.3. Calculation of leakage emissions

According to ACM0002 methodology, version 14.0, no leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (extraction. processing. and transport). These emissions sources are neglected.

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

Table 6: Calculation of emission reductions

	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	89,734	0	0	0	89,734	0	89,734

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

Table 6: Comparison of emission reductions 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)
89,734	71,666

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

The amount estimated ex ante for this monitoring period in the PDD considered the following parameters:

$EG_{facility,y}$ = 51,500 MWh/year
$EF_{grid,CM2011}$ = 0.1988 tCO_2e/MWh

For seven complete years, the emission reductions amount estimated ex ante was 71,666 tCO_2e (51,500 MWh/year X 0.1988 tCO_2e/MWh X 7 = 71,666 tCO_2e [8]).

E.6. Remarks on increase in achieved emission reductions

The increase in achieved emission reductions was due to higher $EF_{grid,CM,y}$ in all years of the monitoring period. $EF_{grid,CM,y}$ of the PDD registered was based on 2011 data which was the latest data available when the PDD was registered. This increase in the $EF_{grid,CM,y}$ is associated with the higher levels of GHG-intensive electricity generation in the years of the monitoring period comparing to the levels of 2011.

Table below shows a comparison of $EF_{grid,CM,y}$ of all years from the monitoring period comparing to levels 2011.

[8] Rounded down as the registered PDD.

Table 8: $EF_{grid,CM,y}$ during de Monitored Period

Year	Ex-Ante Estimated $EF_{grid,CM,y}$ in the PDD (tCO_2e/MWh) (A)	Monitored $EF_{grid,CM,y}$ (tCO_2e/MWh) (B)	Variation (%) (B/A - 1)
2015	0.1988	0.4075	105%
2016	0.1988	0.3904	96.4%
2017	0.1988	0.2955	48.6%
2018	0.1988	0.3380	70%
2019	0.1988	0.3100	55.9%
2020	0.1988	0.2759	38.8%
2021	0.1988	0.3263	64.13%

$EG_{facility,y}$ used for PDD ex-ante estimation was 51,500 MWh/year (totalizing 309,000 MWh for six years). The project delivered 25.7% less than projected for the monitoring period.

Table 9: $EG_{facility}$ variation in the Monitored Period

Year	Ex-Ante Estimated $EG_{facility,y}$ in the PDD (MWh) (A)	Monitored $EG_{facility,y}$ (MWh) (B)	Variation (%) (B/A - 1)
2015	51,500	52,208	1.4%
2016	51,500	46,171	-10.3%
2017	51,500	32,594	-36.7%
2018	51,500	36,552	-29.0%
2019	51,500	38,579	-25.1%
2020	51,500	23,630	-54.1%
2021	51,500	27,978	-45.7%
Total	**360,500**	**260,760**	**-27.6%**

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

Not applicable. The project is not a small scale project activity.

Document information

Version	*Date*	*Description*
09.0	8 October 2021	Revision to: • Ensure consistency with version 03.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN).
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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