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	Teles Pires Hydropower Plant Project Activity	
UNFCCC reference number of the project activity	9301	
Version number of the PDD applicable to this monitoring report	7.1	
Version number of this monitoring report	5.1	
Completion date of this monitoring report	15/03/2019	
Monitoring period number	first monitoring period	
Duration of this monitoring period	07/11/2015 – 31/01/2017	
Monitoring report number for this monitoring report	Not applicable	
Project participants	Companhia Hidrelétrica Teles Pires Ecopart Assessoria em Negócios Empresariais Ltda.	
Host Party	Brazil	
Sectoral scopes	1 – Energy industries (renewable - / non-renewable sources)	
Applied methodologies and standardized baselines	ACM0002 - Consolidated baseline methodology for grid-connected electricity generation from renewable sources (version 13.0.0)	
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	1,473,640
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	3,128,649	

SECTION A. Description of project activity

A.1. General description of project activity

The primary objective of the Teles Pires Hydropower Plant Project Activity (hereafter referred to as the "Project" or "UHE[1] Teles Pires") is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to the environmental, social and economic sustainability by increasing renewable energy's share of the total Brazilian (and the Latin America and the Caribbean region's) electricity consumption.

UHE Teles Pires consists of a *greenfield* project type where no renewable power plant was operated prior to the implementation of the Project and it reduces greenhouse gas emissions through renewable electricity generation supplied to the grid ("SIN" from the Portuguese *Sistema Interligado Nacional*). In the baseline scenario, this additional electricity would be generated by the existing and new grid-connected power plants. Therefore, the baseline scenario and the scenario prior to the implementation of the Project are the same.

During the monitoring period from 07/11/2015 to 31/01/2017, the Project reduced 1,473,640 tCO_2.

A.2. Location of project activity

The Project is located in Teles Pires River, between the cities of Paranaita (MT) and Jacareacanga (PA), Brazil, under the following coordinates[2]:

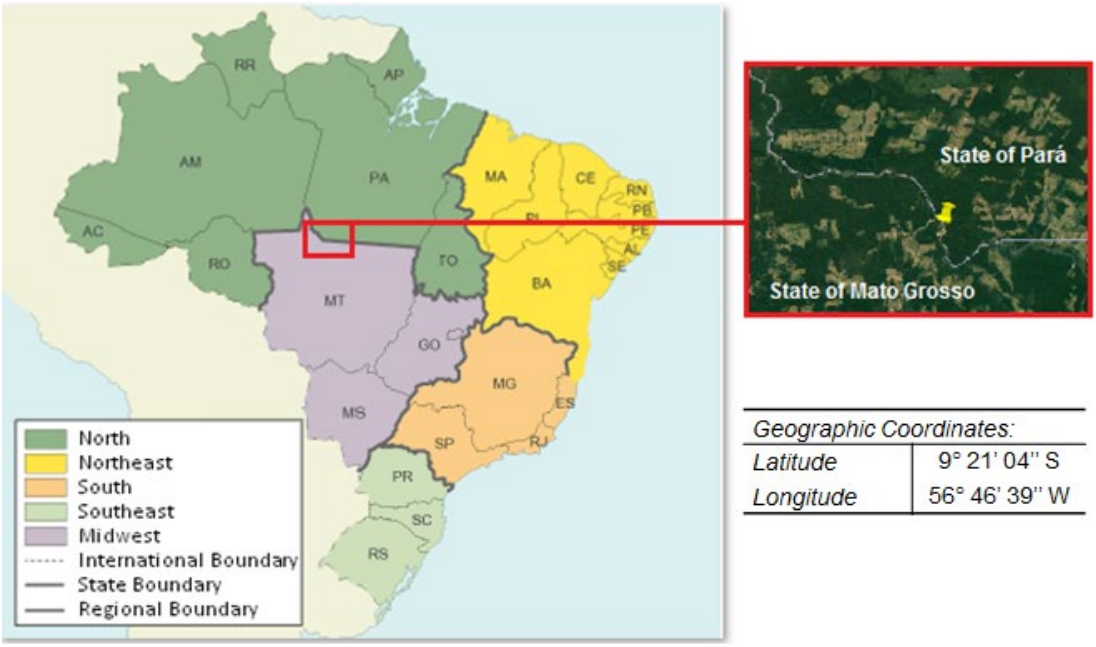

Figure 1 – UHE Teles Pires location and geographic coordinates

[1] UHE stands for "Usina Hidroelétrica" (Hydropower Plant).

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 Party)	Private entity: Companhia Hidrelétrica Teles Pires	No
	Private entity: Ecopart Assessoria em Negócios Empresariais Ltda.	
United Kingdom of Great Britain and Northern Ireland	Private entity: Ecopart Assessoria em Negócios Empresariais Ltda.	No

A.4. Reference to applied methodologies and standardized baselines

ACM0002 - Consolidated methodology for grid-connected electricity generation from renewable sources (version 13.0.0). ACM0002 also refers to the following tools applicable to the Project:

- Tool for demonstration and assessment of additionality (version 06.0.0);
- Tool to calculate the emission factor for an electricity system (version 2.2.1).

A.5. Crediting period type and duration

07/11/2015 – 06/11/2025 (fixed)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

(a) *Description of the installed technology, technical processes and equipment;*

The Project has 1,820.025 MW installed capacity and 146.5 km^2 reservoir area at the "maximum-maximorum" reservoir level (220.44 m) [2]. The Project has five Francis turbines with 370.10 MW nominal power each and five three-phase synchronous generators with 404.45 MVA nominal power each[3]. The Project started operations in November 2015. During the monitoring period from 07/11/2015 to 31/01/2017, the Project reduced 1,473,640 tCO_2.

[2] Generators' tag present 1,820.025 MW installed capacity: 404,450 kVA x 0.9 = 364,005 kW x 5 generating units = 1,820.025 MW. Although the registered PDD does not present decimal places, the slight 0.025 MW difference (less than 0.01%) cannot be considered relevant. The reservoir area is according to ANEEL Technical Record – Appendix 3 signed by Voith, CNO and Alstom. In spite of the difference of installed capacity and reservoir area presented in the PDD, it has immaterial impact on generation of emission reductions (see Decision -/CMP.7 - Materiality standard under the clean development mechanism), the project additionality (no additional investment was made), applicability of the methodology (the project is still under the power density criteria) or requirement to change the registered PDD (installed capacity and reservoir area are both monitored parameters). ACM0002 (version 13.0) requires monitoring of Cap_{PJ} and A_{PJ} parameters, indicating that these parameters are not fixed/immutable during the crediting period. This issue was addressed by DOE in Appendix 1 of the Verification Report. Also refer to section B.2 below. For the reservoir level and area see "UHE Teles Pires - Operação do Vertedouro: Manual (2017)."

[3] According to equipment's tag.

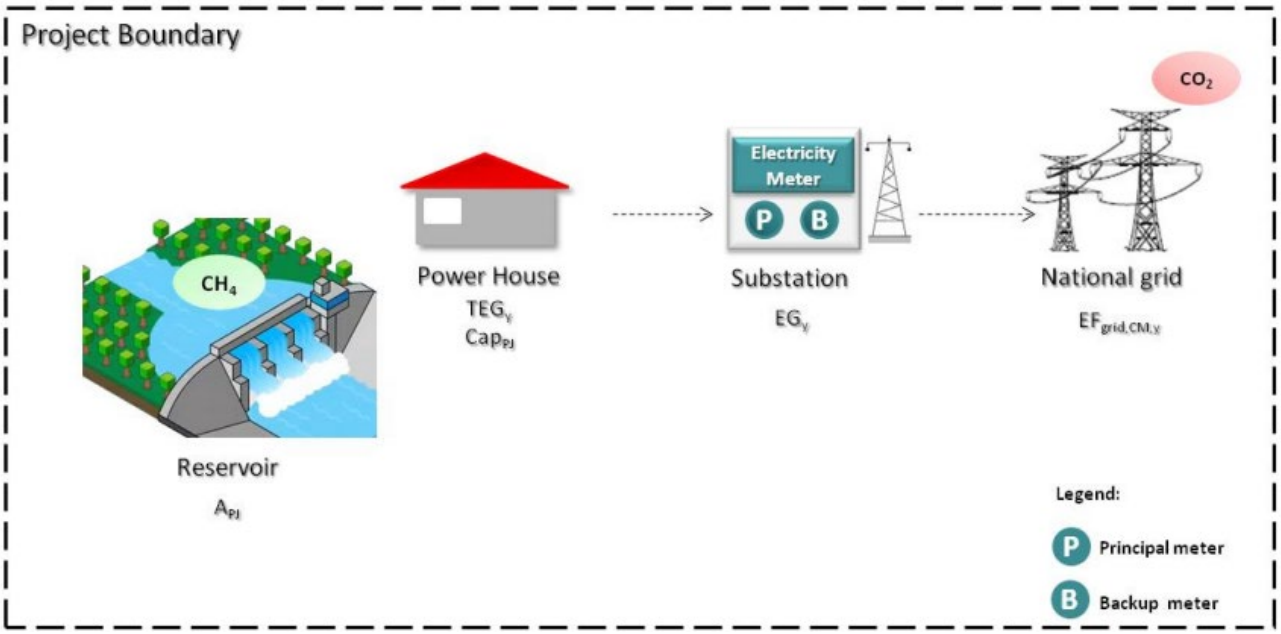

Figure 2 – Project boundary including process and emission sources

(b) Information on the implementation and actual operation of the project activity, including relevant dates (e.g. construction, commissioning, start of operation).

Commissioning and operation start-up occur for each generating unit. Then, the operation startup of the project is when the first generating unit started operation (UG1) on 07/11/2015, *i.e.* the start of the monitored period.

Milestones of the project activity are presented in the following table.

Table 1 – Relevant dates of the project activity

Date	Action	Reference
19/08/2011	Issuance of Construction License by IBAMA[4]	IBAMA LI # 818/2011
19/08/2011	Signature of the EPC contract and construction start	Contract signed on 19/08/2011 between the Project Participant and the Constructor Consortium
28/12/2012	CDM registration	The UNFCCC's website[5]
19/11/2014	Issuance of Operation License by IBAMA	IBAMA LO # 1,272/2014
03/10/2015	Commissioning startup UG1, UG2 and UG3	ANEEL Ordinance # 3,375, 02/10/2015
07/10/2015	Commissioning startup UG4	ANEEL Ordinance # 3,407, 06/10/2015
07/11/2015	Commercial operation startup UG1	ANEEL Ordinance # 3,646, 06/11/2015

[4] IBAMA is the Brazilian Institute of Environmental and Renewable Natural Resources (the host country environmental agency).

[5] The registration action occurred on 11/07/2013. Available at: <https://cdm.unfccc.int/Projects/DB/PJR%20CDM1356623851.07/view>

30/12/2015	Commercial operation startup UG2	ANEEL Ordinance # 4,151, 29/12/2015
02/07/2016	Commissioning startup UG5	ANEEL Ordinance # 1,756, 01/07/2016
04/08/2016	Commercial operation startup UG3, UG4 and UG5	ANEEL Ordinance # 2,103, 03/08/2016

As indicated in the registered PDD (version 7.0, dated 04/10/2012, page 5), technical specifications of the project could be changed:

> *"The following technical information is retrieved from the Final Consolidated Basic Project (PBC from the Portuguese "Projeto Básico Consolidado"), approved by the Brazilian Electricity Regulatory Agency (ANEEL from the Portuguese, "Agência Nacional de Energia Elétrica") on 26 August 2011. Still, it shall be clear that during the construction the project and, consequently, some technical specifications, may suffer small changes.*

Therefore, the following technical differences were identified during site visit when compared to the registered PDD:

- Reservoir water level: it changed from 220m to 220.40 m, affecting reservoir area, which increased from 134.7km^2 to 146.50km^2. Changes applied due to topographical differences, necessary for adjustments in water levels upstream and downstream. This change does not affect the applicability of the methodology, since the power density criteria remains above 10W/m^2.
- Installed capacity: the registered PDD does not present decimal places in installed capacity (1,820 MW). While considering generators tag, the resulted installed capacity is 1,820.025 MW: 404,450 kVA x 0.9 = 364,005 kW x 5 generating units = 1,820.025 MW. However, this change does not affect the effective output capacity.
- Turbine capacity: it changed from 369.7 MW to 370.10MW each. Is spite of the difference, there were no changes in effective output capacity.
- Calibration frequency: registered PDD presented 2-year calibration period based on applicable ONS procedures at the time. According to the updated ONS procedures, valid from 01/01/2017 onwards, energy meter calibration shall be done in a 5-year period[6]. Although there was a revision of the ONS procedures, the PDD states that "*the Project owner will proceed with the necessary monitoring measures as established in the applicable official procedures from ONS, ANEEL and, CCEE*".

In spite of the differences stressed above, changes cannot be considered relevant as they have immaterial impact on generation of emission reductions (see Decision -/CMP.7 - Materiality standard under the clean development mechanism). Furthermore, there is no impact on additionality (no additional investment was made) and applicability of the methodology (no small scale or power density criteria impacted). Additionally, the PDD was prepared during the project construction/equipment purchase and before the operation startup, which commonly occurs for hydropower projects considering CDM revenues. For this reason, changes may occur during this phase, differently than solar or wind projects, which equipment are pre-manufactured and power capacity are established. Then, it was the Project Participants' understanding that there is no necessity for revising the PDD. Nevertheless, the previous request for issuance submitted in December 2018 was considered incomplete on 30/Jan/2019. Therefore, the present revised MR (together with a revised PDD) has been prepared for a new request for issuance submission with a post registration changes under the issuance track.

[6] Available at ONS's website: <http://ons.org.br/pt/paginas/sobre-o-ons/procedimentos-de-rede/vigentes>

B.2. Post-registration changes

The present version of the monitoring report (MR) is done in order to apply the procedures described in the Appendix of the Project Standard (post-registration changes suitable for approval under the issuance track), with the submission of a revised PDD (in track-changes as well as in clean versions).

In the project participants' opinion, all the above mentioned post registration changes (see "B.1 - Description of implemented project activity") are immaterial and were all acknowledged and detailed in the previous version of the monitoring report submitted in December 2018, as well as repeated in the present version of the MR.

Nevertheless, the request for issuance was considered incomplete on 30/Jan/2019. One of the reasons for that was that the PPs did not consider necessary so submit a revised PDD.

It was the understanding of the PPs that an immaterial change needs to be acknowledged and its immateriality demonstrated. Once demonstrated immaterial, the change should be treated as such and no further actions would be required. Otherwise, there will be no difference in the consideration of material and immaterial changes.

This was not the understanding of the Secretariat, the request for issuance was considered incomplete, and the PPs were required to prepare a revised PDD (as per paragraph 230 of the CDM Standard for Project Activities).

Therefore, the present revised MR (together with a revised PDD) has been prepared for a new request for issuance submission. In other words, all corrections are being submitted with this monitoring report as part of the the request for issuance (post-registration change – issuance track) as applicable from this monitoring period. For the corrections/changes referred here (see summary list below and details in item B.1 above), a revised PDD (version 7.1, completed on 15-Mar-2019) is provided to the DOE for validation.

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

Due to delays in the operation startup of the project, the Project Participants notified the secretariat on 12/07/2016 regarding the change of the crediting period from 01/01/2015 – 31/12/2024 to 07/11/2015 – 06/11/2025.

Since the change is up to one year, the PPs are not required to request for approval by the Board of the change, but my means of a notification only following § 128 of the CDM Project Cycle Procedure for Project Activities (version 1.0)[7].

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

The permanent changes to the monitoring plan since the registration of the project activity are the following:

(a) Changes that have been approved by the Board as applicable from the period prior to this monitoring period;

Not applicable

(b) Changes that have been approved by the Board as applicable from this monitoring period;

Not applicable

(c) Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration changes - issuance track) as applicable from this monitoring period.

1. Calibration frequency: registered PDD indicated 2-year calibration period based on applicable ONS procedures at the time. According to the updated ONS procedures, valid from 01/01/2017 onwards, energy meter calibration shall be done in a 5-year period.

B.2.6. Changes to project design

The changes to the project designs since the registration of the project activity are the following:

(d) Changes that have been approved by the Board as applicable from the period prior to this monitoring period;

Not applicable

(e) Changes that have been approved by the Board as applicable from this monitoring period;

Not applicable

(f) Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration changes - issuance track) as applicable from this monitoring period.

1. Reservoir water level: it changed from 220m to 220.40 m, affecting reservoir area, which increased from 134.7km^2 to 146.50km^2.
2. Installed capacity: While considering generators tag, the resulted installed capacity is 1,820.025 MW: 404,450 kVA x 0.9 = 364,005 kW x 5 generating units = 1,820.025 MW (instead of 1820 MW).

[7] At the time of the notification submission to the secretariat, §148 and §149 of the CDM Project Cycle Procedure (version 5.0) were applied.

3. Turbine capacity: it changed from 369.7 MW to 370.10MW each.

SECTION C. Description of monitoring system

The monitoring plan of the project emission reductions is in accordance with the procedures set by ACM0002 (version 13.0.0).

The Project owner proceeds with the necessary monitoring measures as established in the applicable official procedures from ONS, ANEEL and CCEE. ONS is the Brazilian Interconnected Power System Operator and is responsible for coordinating and controlling the operation of generation and transmission facilities in the SIN under supervision and regulation of ANEEL. ANEEL is the Brazilian regulatory agency and regulates and supervises the electricity generation, transmission, distribution and commercialization. CCEE is the Chamber of Electric Energy Commercialization, responsible for carrying out the wholesale transactions and commercialization of electric power within the SIN, for regulated and free markets (ACR and ACL). Parameters to be monitored for Teles Pires project are as follows:

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid in year y ($EG_{facility,y}$);

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ});

(iii) Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ});

(iv) Grid operating margin ($EF_{grid,OM,y}$).

(i) Quantity of net electricity generation supplied by the project plant/unit to the grid in year y ($EG_{facility,y}$).

The total electricity exported to the grid is monitored by Companhia Hidrelétrica Teles Pires following the procedures and requirements established by ONS, which defines the technical characteristics and precision class of 0.2% of maximum permissible error for the electricity meters to be used[8]. In addition, ONS also governs the electricity meter calibration requirements, which should be carried out every two years[9] and performed by an entity accredited under the Brazilian Calibration Net (from the Portuguese “Rede Brasileira de Calibração” – RBC).

In UHE Teles Pires, there are four energy meters (ION8600 / Schneider) - two for each transmission line (LT1 and LT2) with double/redundant metering, all located at the local substation (SE Paranaíta) as follows:

Table 2 – Description of energy meters located at SE Paranaíta[10]

Description	Serial number
LT1 main meter	PT-1212A173-01, substituted for

[8] ONS. Grid Procedures – Module 12: measurement for billing/Submodule 12.2 Installation of the measurement for billing (from the Portuguese Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.2: Instalação do sistema de medição para faturamento). Available at http://apps05.ons.org.br/procedimentorede/procedimento_rede/procedimento_rede.aspx.

[9] ONS. Grid Procedures – Module 12: measurement for billing/Submodule 12.3 Maintaneance of the system of measurement for billing (from the Portuguese Procedimentos de Rede – Módulo 12: medição para faturamento / Submódulo 12.3: Manutenção do sistema de medição para faturamento). Available at http://apps05.ons.org.br/procedimentorede/procedimento_rede/procedimento_rede.aspx.

[10] Documentation with detailed historic of maintenance of meters and calibration certificates covering the monitoring period submitted to the DOE.

	MW-1602A158-02 (procedure resumed on 12-Jul-2016[11])
LT1 backup meter	MT-1306A028-01
LT2 main meter	MT-1212A059-01
LT2 backup meter	PT-1212A044-01

Energy information is controlled in real time by CCEE. Once the measurement points are physically defined and the invoice measurement system and the communication infrastructure are installed, the measurement points are registered in the SCDE (System of Energy Data collection) managed by CCEE.

Energy consumed by the project from the grid is discounted from the energy dispatched into the grid. Evidences of the consumptions are invoices from the local utility (ENERGISA). Invoices from November 2015 to January 2017 are available and were submitted to the DOE.

(ii) Installed capacity of the hydro power plant after the implementation of the project activity (Cap_{PJ})

Installed capacity of the power plant can be checked by DOE during on-site visit at every verification and cross-checked with official documents, *e.g.* ANEEL resolution.

(iii) Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ})

The reservoir area is monitored through topographical studies (made at the time of the project design) and water reservoir levels, which is monitored in real time by the project sponsors. The water level to be compared with the topographical study is based on the average water level that is monthly consolidated. Data can be cross-checked with official documents, e.g. engineering/environmental studies and/or ANEEL Summary sheet.

(iv) Grid operating margin ($EF_{grid,OM,y}$)

The grid operating margin is calculated according to ACM0002 and the "Tool to calculate the emission factor for an electricity system" applying values from the Brazilian DNA for option (c) of the tool: Dispatch data analysis OM. This value is updated during the Project verification as published by the Brazilian DNA.

Teles Pires Hydropower Plant Project Activity is also responsible for the equipment's maintenance, for dealing with possible monitoring data adjustments and uncertainties, for review of reported results/data, for internal audits of GHG project compliance with operational requirements and for corrective actions. Yet, it is also responsible for the project management, as well as for organizing and training of the staff in the appropriate monitoring, measurement, and reporting techniques.

It is important to mention that ANEEL can visit the plant and inspect operation and maintenance of the facilities at any time. Yet, during the periodic verifications, the plant will provide all the necessary documents evidencing the amount of net energy exported to the grid. This data is going to be kept for at least two years after the crediting period ends. All data collected on-site will be checked internally before being compiled in an electronic format, to ensure that it is complete and of appropriate quality. A final check of the data and project analysis prior to any verification will be carried out.

[11] The process to change the meter initiated (approval to proceed with the meter change and all related procedures) on 14-Jun-2016 and resumed on 12-Jul-2016.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	W_{OM}
Unit	Fraction
Description	Weighting
Source of data	"Tool to calculate the emission factor for an electricity system"
Value(s) applied	0.5
Choice of data or measurement methods and procedures	Default weight value for Operating Margin according to the "Tool to calculate the emission factor for an electricity system".
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	-

Data/Parameter	W_{BM}
Unit	Fraction
Description	Weighting
Source of data	"Tool to calculate the emission factor for an electricity system"
Value(s) applied	0.5
Choice of data or measurement methods and procedures	Default weight value for Build Margin according to the "Tool to calculate the emission factor for an electricity system".
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	-

Data/Parameter	$EF_{grid,BM,y}$
Unit	tCO_2/MWh
Description	Grid build margin
Source of data	The Brazilian Designated National Authority
Value(s) applied	0.1404
Choice of data or measurement methods and procedures	BM is calculated according to methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" by the Brazilian DNA. Project proponents chose Option 1: calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group m at the time of CDM-PDD submission to the DOE for validation.

Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	Official source of data from 2010 year.

Data/Parameter	Cap_{BL}
Unit	W
Description	Installed capacity of the hydro power plant before the implementation of the project activity (W)
Source of data	ACM0002
Value(s) applied	0.0
Choice of data or measurement methods and procedures	The project consists of a new power plant. As defined in the methodology, for new hydro power plants, this value is zero.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	-

Data/Parameter	A_{BL}
Unit	m^2
Description	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the eservoir is full (m2). For new reservoirs, this value is zero
Source of data	ACM0002
Value(s) applied	0.0
Choice of data or measurement methods and procedures	The project consists of a new power plant. As defined in the methodology, for new hydro power plants, this value is zero.
Purpose of data/parameter	Calculation of project emissions.
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 plant to the grid in year y
Measured/calculated/ default	Measured

<table>
<tr><td>Source of data</td><td>Electricity meter(s)</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Year</th><th>$EG_{facility,y}$</th></tr>
<tr><td>2015</td><td>126,457</td></tr>
<tr><td>2016</td><td>2,962,165</td></tr>
<tr><td>2017</td><td>899,515</td></tr>
<tr><td>Total</td><td>3,988,138</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Electricity meter(s), monitoring period from Nov-2015 to Jan-2017
<u>Location: SE Paranaíta, LT1 meter at operation start, November 2015</u>
Type: ION 8600C
Accuracy: 0.2
Serial number: PT-1212A173-01 (main) / MT-1306A028-01 (backup)
Calibration Date: 30/09/2015
Calibration frequency: 2 years up to 2016 and 5 years from 2017 onwards

On 12/07/2016[11] the <u>main</u> meter was replaced by:
Type: ION 8650
Accuracy: 0.2
Serial number: MW-1602A158-02
Calibration Date: 20/03/2016
Calibration frequency: 2 years up to 2016 and 5 years from 2017 onwards.

It shall be noted that during the corrective procedure period, both, the old and the new meters calibration certificates were valid (old meter PT-1212A173-01, calibrated on 30/09/2015, certificate valid up to 29/09/2017, and, new meter MW-1602A158-02, calibrated on 20/03/2016, certificate valid up to 19/03/2018).

<u>Location: SE Paranaíta, LT2 meter at operation start, November 2015</u>
Type: ION 8600C
Accuracy: 0.2
Serial number: MT-1212A059-01 (main) / PT-1212A044-01 (backup)
Calibration Date: 30/09/2015
Calibration frequency: 2 years up to 2016 and 5 years from 2017 onwards</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Continuous measurement and at least monthly recording.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>According to ACM0002, (i) the quantity of electricity supplied by the project plant/unit to the grid and (ii) the quantity of electricity delivered to the project plant/unit from the grid shall be monitored. The measurement of this parameter is based on data from energy meters installed at the substation, following Module 12 of the Procedures established ONS.</td></tr>
<tr><td>QA/QC procedures</td><td>Equipment has by legal requirements extremely low level of uncertainty. CCEE data can be used to cross check information.</td></tr>
</table>

Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	-

Data/Parameter	$EF_{grid,OM,y}$
Unit	tCO_2/MWh
Description	Grid operating margin
Measured/calculated/ default	Calculated
Source of data	The Brazilian Designated National Authority
Value(s) of monitored parameter	Year: $EF_{grid,OM,y}$ 2015: 0.5538 2016: 0.6189 2017: 0.5381
Monitoring equipment	-
Measuring/reading/recording frequency	Hourly, since the project applies option (c): Dispatch data analysis OM.
Calculation method (if applicable)	OM is calculated according to ACM0002 and the "Tool to calculate the emission factor for an electricity system" applying values from the Brazilian DNA.
QA/QC procedures	Official source of data.
Purpose of data/parameter	Calculation of baseline emissions.
Additional comments	-

Data/Parameter	Cap_{PJ}
Unit	MW
Description	Installed capacity of the hydro power plant after the implementation of the project activity
Measured/calculated/ default	Default
Source of data	Project site
Value(s) of monitored parameter	1,820.025
Monitoring equipment	Equipment's tag
Measuring/reading/recording frequency	Yearly

Calculation method (if applicable)	The installed capacity is determined based on recognised standards.
QA/QC procedures	In Brazil the installed capacity of hydropower plant is determined and authorized by the competent regulatory agency. Any modification has to be authorized and be publicly available. Hence, on a yearly basis, any new authorization to increase the installed capacity of the plant is monitored.
Purpose of data/parameter	Calculation of project emissions.
Additional comments	The registered PDD does not mentioned decimal places and, therefore, it presents 1,820MW installed capacity. Nevertheless, the effective output capacity of the project did not change.

Data/Parameter	A_{PJ}
Unit	km^2
Description	Area of the reservoir measured on the surface of the water, after the implementation of the project activity, when the reservoir is full.
Measured/calculated/ default	Calculated
Source of data	Project Developer
Value(s) of monitored parameter	Year / Water Level (m) / A_{PJ} 2015 / 220.43 / 146.2 2016 / 220.33 / 143.6 2017 / 220.44 / 146.5
Monitoring equipment	Water level measured with electronic devices and compared to topographical studies from the project design.
Measuring/reading/recording frequency	Monthly
Calculation method (if applicable)	Based on studies of quota x area x volume curves. The project's reservoir area under the normal maximum water level of 220.44 m is 146.50 km^2.
QA/QC procedures	In Brazil, every modification carried out in hydropower plants has to and be made publicly available and authorized by the responsible regulatory agency
Purpose of data/parameter	Calculation of project emissions.
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

Baseline emissions include only CO2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology 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 emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y} \quad \text{Equation 1}$$

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)

Calculation of $EG_{PJ,y}$

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, thus EGPJ,y is calculated according to option (a) Greenfield renewable energy power plants as follows:

$$EG_{PJ,y} = EG_{facility} \quad \text{Equation 2}$$

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)

$EG_{facility,y}$ Quantity of net electricity generation supplied by the project plant/unit to the grid in year *y* (MWh/yr)

Electricity delivered to the grid by UHE Teles Pires is presented as follows:

Table 3 – Net electricity dispatched to the grid during the monitoring period

	Electricity dispatched into the grid (MWh)		
	2015	**2016**	**2017**
January		158,255	899,515
February		204,575	
March		233,390	
April		218,363	
May		216,052	
June		289,217	
July		209,309	
August		152,540	

September		172,992	
October		234,139	
November	78,158	402,889	
December	48,299	470,446	
Yearly total	**126,457**	**2,962,165**	**899,515**

Determination of $EF_{grid,CM,y}$

The Project Activity is connected to the Brazilian National Interconnected System (SIN). The grid emission factor is calculated by the Brazilian DNA, according to the "Tool to calculate the emission factor for an electricity system".

Step 1: Identify the relevant electricity systems

By means of the Resolution number 8[12], issued on May 26th, 2008, the Brazilian DNA, delineated the electricity system as the National Interconnected Grid (SIN) for CDM purposes. It covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest) as presented in the below.

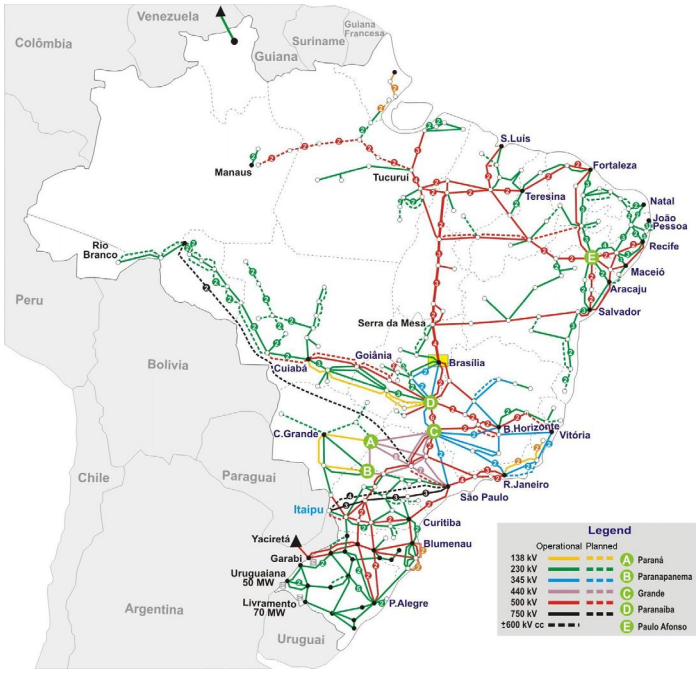

Figure 3 – Brazilian Interconnected System. (Source: ONS)

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

The option chosen to calculate the operating margin and build margin emission factor is Option I: Only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is calculated by the Brazilian DNA[12] based on the following method: Option (c): Dispatch data analysis OM.

Step 4: Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM-DD,y}$) is determined based on the grid power units that are actually dispatched at the margin during each hour h where the project is displacing grid electricity. The emission factor is calculated as follows:

$$EF_{grid,OM-DD,y} = \frac{\sum_{h} EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}} \qquad \text{Equation 3}$$

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)
$FE_{EL,DD,h}$	CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh)
$EG_{PJ,y}$	Total electricity displaced by the project activity in year *y* (MWh)
h	Hours in year *y* in which the project activity is displacing grid electricity
y	Year in which the project activity is displacing grid electricity

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

Project participants do not have access to the Brazilian DNA calculation of the hourly emission factor nor to the spreadsheet used. Only final values are available for public consultation.

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

Project participants do not have access to the Brazilian DNA determination of the set of power units *n* nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation.

Based on hourly CO_2 OM emission factor of the grid published by the Brazilian DNA and UHE Teles Pires hourly electricity generation, the OM EF was calculated as follows:

Table 4 – CO_2 OM emission factor from 2015 to 2017

Year	OM EF (tCO_2/MWh)
2015	0.5538
2016	0.6189
2017	0.5381

Step 5: Calculate the build margin (BM) emission factor

[12] Available at: http://www.mct.gov.br/index.php/content/view/74689.html

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

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad \text{Equation 4}$$

Where:

$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
$FE_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m	Power units included in the build margin
y	Most recent historical year for which power generation data is available

Calculation to determine the set of power units m included in the build margin

Project participants do not have access to the Brazilian DNA determination of the set of power units *m* nor to the spreadsheet used. Only final values for the hourly emission factor ($EF_{EL,DD,h}$) are available for public consultation.

Calculation of the CO_2 emission factor for each power unit m ($EF_{EL,m,y}$)

Project participants do not have access to the Brazilian DNA calculation of the CO_2 emission factor for each power unit *m* nor to the spreadsheet used. Only final values are available for public consultation.

In terms of vintage of data, project participants chose: option 1 (*ex-ante*). Therefore, data fixed in the registered PDD is used: 0.1404 tCO_2/MWh.

Step 6: Calculate the combined margin (CM) emission factor

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

(a) Weighted average CM; or

(b) Simplified CM.

The weighted average CM method (option A) should be used as the preferred option according to equation below:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \cdot \omega_{OM} + EF_{grid,BM,y} \cdot \omega_{BM} \quad \text{Equation 5}$$

Where:

$EF_{grid,CM,y}$	Combined 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)
$EF_{grid,BM,y}$	Build margin CO_2 emission factor in year *y* (tCO_2/MWh
ω_{OM}	Weighting of operating margin emission factor (%)
ω_{BM}	Weighting of build margin emission factor (%)

For ω_{OM} and ω_{BM}, the default value of 0.5 shall be used according to the "Tool to calculate the emission factor for an electricity system". Applying values presented above, the CO_2 CM EF is as follows:

Table 5 – CO_2 combined margin emission factor

Year	OM EF (tCO_2/MWh)	BM EF (tCO_2/MWh)	CM EF (tCO_2/MWh)
2015	0.5538	0.1404	0.3471
2016	0.6189	0.1404	0.3796
2017	0.5381	0.1404	0.3393

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

The project emissions are accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad \text{Equation 6}$$

Where:

PE_y Project emissions in year y (tCO_2e/yr)

$PE_{FF,y}$ Project emissions from fossil fuel consumption in year *y* (tCO_2e/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)

According to the methodology, project emissions due to fossil fuel combustion and emissions of non-condensable gases from the operation of geothermal power plants are set to zero for hydropower projects ($PE_{GP,y} = PE_{HP,y} = 0$).

Emissions from water reservoirs of hydro power plants ($PE_{HP,y}$)

As per the ACM002, for hydro power project activities that result in new single or multiple reservoirs:

- The methodology is not applicable if the power density (*PD*) of the project activity is less or equal to 4 W/m^2;
- CH_4 and CO_2 emissions from the reservoir shall be accounted if the power density of the project activity is greater than 4 W/m^2 and less than or equal to 10 W/m^2 and;
- Emissions from water reservoir are set to zero if the power density of the project activity is greater than 10 W/m^2.

Project emissions from water reservoirs are calculated as follows:

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \quad \text{Equation 7}$$

Where:

$PE_{HP,y}$ Project emissions from reservoirs of hydropower plants in year *y* (tCO_2e);

EF_{Res} Default emission factor for emissions from reservoirs of hydro power plants, and the default value as per EB 23 is 90 kg CO_2e/MWh;

TEG_y Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh).

The power density of the project activity is determined as per the equation below:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ Equation 8

Where:

PD Power density of the project activity, in W/m^2

Cap$_{PJ}$ Installed capacity of the hydro power plant after the implementation of the project activity (W)

Cap$_{BL}$ Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero

A$_{PJ}$ Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2);

A$_{BL}$ Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero.

The project's reservoir area under the normal maximum water level of 220.44 m is 146.50 km2. The reservoir area includes the normal river bed and, therefore, the increased flooded area is lower than 146.50 km². In spite of the methodology determination for ABL to be zero for new reservoirs, a few projects were registered discounting the river bed (ABL = surface area of the river before the implementation of the project). All of them base their procedure in a clarification approved by the CDM EB13, where one reads: "in order to calculate power density, the correct equation will be the increased power capacity divided by the increased flooded area measured in the water surface". Additionally, there is at least one case of a project with new reservoir and using ACM0002 (version 7), which provisions for ABL to be zero for new reservoirs, that changed its power density post-registration, discounting the surface area of the river (see project 2539). In spite of the flooded area should be used for power density criteria, the reservoir area is considered for calculation of emission reduction purposes as a very conservative approach taken by the Project Participants:

$$PD = \frac{1820.025 - 0}{146.50 - 0} = 12.42 \text{ W/m}^2$$

During the monitored period, water levels from reservoir were monitored to identify any increase in reservoir area of the project. Results are presented as follows:

Year	Water level (m)	Reservoir area (km^2)
2015	220.43	146.20
2016	220.33	143.60
2017	220.44	146.50

E.3. Calculation of leakage emissions

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 (e.g. extraction, processing, and transport). These emissions sources are neglected.

[13]AM_CLA_0049 available at <http://cdm.unfccc.int/methodologies/DB/AS1DOF3L010BY57ZT2UZNQ8Y9K83CN/view.html>.

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	1,473,640	0	0	0	1,473,640	1,473,640

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)
1,473,640	3,128,649

E.6. Remarks on increase in achieved emission reductions

Not applicable, since there was no increase in the actual GHG emission reductions to the ones estimated in the registered PDD considering the monitoring period.