



5TH VERIFICATION SALTO PILÃO HYDROPOWER PLANT PROJECT ACTIVITY



Document Prepared by Ecopart Assessoria em Negócios Empresarial Ltda

Project Title	<i>Salto Pilão Hydropower Plant Project Activity</i>
Version	3.5
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Date of Issue	<i>14-February-2022</i>
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2 PROJECT DETAILS

2.1 Summary Description of the Implementation Status of the Project

Salto Pilão project activity consists of the implementation of a hydropower plant with 191.88 MW¹ installed capacity and 0.15 km²² reservoir area. The plant is located between the cities of Lontras, Ibirama and Apiúna, state of Santa Catarina, Southern region of Brazil.



Figure 1 – Salto Pilão Hydropower Plant (source: CESAP's website)

Salto Pilão hydropower plant (from Portuguese Usina Hidrelétrica Salto Pilão - UHESP) is owned by an association of several companies called Consórcio Empresarial Salto Pilão. The UHESP starting date is December 11th, 2009, when the first generating unit started operation. The starting date of the crediting period is considered as the date on which both generating units of UHESP started operations, i.e. January 19th, 2010. UHESP will have a maximum of 10 years of crediting period. The current consortium structure is as follows³:

- Companhia Brasileira de Alumínio (CBA): 60%;
- Companhia Geração de Energia de Pilão (CGEP): 20%; and
- DME Energética Ltda. (DMEE): 20%.

The renewable electricity generated by the project has important contribution to environmental sustainability by reducing carbon dioxide emissions that would have occurred otherwise in the absence of the Project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation by fossil fuel sources (and CO₂ emissions), which would be generated (and emitted) in its

¹ Equipment tag following the definitions for “installed power generation capacity” of ACM0002 (version 11).

² Operation License # 4055/2012, issued on May 31st, 2012 by the environmental agency of Santa Catarina State (Fundação do Meio Ambiente – FATMA).

³ Information available at CESAP's website: <<http://www.usinasaltopilao.com.br/institucional>>.

absence. This monitoring report presents information related to the **fifth verification** of the project activity, which covers the period of January 1st, 2018 to January, 18st 2020. The total emission reductions by the project activity over the monitored period are **518,810 tCO₂e**.

2.2 Sectoral Scope and Project Type

Sectoral Scopes: 1 - Energy industries (renewable - / non-renewable sources).

The project consists in a hydroelectricity power plant presented as a single project, i.e. it is not a grouped project

2.3 Project Proponent

Organization name	Consórcio Empresarial Salto Pilão - CESAP
Contact person	Luís Cláudio Ribeiro
Title	Manager
Address	Av. Desembargador Vitor Lima, nº. 260 – ático, 88040-400, Florianópolis, SC, Brazil
Telephone	+55 (47) 3353-9116
Email	luis@usinasaltopilao.com.br

2.4 Other Entities Involved in the Project

Organization name	Ecopart Assessoria em Negócios Empresariais Ltda.
Role in the Project	Advisory company for the project development under the VCS
Contact person	A. Ricardo J. Esparta
Title	Technical director
Address	R. Padre João Manuel, 222, 01411-000, São Paulo, SP, Brazil
Telephone	+55 (11) 3063-9068
Email	ricardo.esparta@eqao.com.br

2.5 Project Start Date

The UHESP starting date is December 11th, 2009⁴, when the first generating unit started operation.

2.6 Project Crediting Period

1st crediting period: 19-January-2010 to 18-January-2020.

UHESP will have a maximum of 10 years of crediting period (renewable).



2.7 Project Location

The project is located in Itajaí-Açu River, between the cities of Lontras, Ibirama and Apiúna, Santa Catarina State, Southern region of Brazil.

⁴ ANEEL Ordinance nr. 4,597 issued on December 10th, 2009. Available at ANEEL's website: <<http://www.aneel.gov.br/>>.

Figure 2 - Physical location of the Dam (left) and the Power House (right).

Source: GOOGLE EARTH (2021)⁵

Table 1 - Geographic coordinates of the project activity⁶

Location at the project site	Latitude	Longitude
Power House	27°06' S	49°28' W
Dam	27°08' S	49°31' W

2.8 Title and Reference of Methodology

ACM0002 – “Consolidated methodology for grid-connected electricity generation from renewable sources” (version 11).

2.9 Participation under other GHG Programs

Not applicable. The project does participate in other GHG Program, other forms of environmental credit or emission trading program and other binding limits.

2.10 Other Forms of Credit

Not Applicable.

2.11 Sustainable Development Contributions

The project contributes to achieve the Host Country’s development priorities regarding renewable energy generation, local development, employment and income generation, and reduction of greenhouse gases.

The project is in line with the Brazilian government initiatives to increase the renewable energy share in the electric matrix. Through Law # 10,438/2002⁷, the Brazilian government created PROINFA (Program for Alternative Energy Sources) for promoting the renewable electricity generation by celebrating long-term power purchase agreements (20-year period) at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. More recently, the government is promoting

⁵ GOOGLE EARTH (2021). Brazil’s map. Available at: < <http://earth.google.com/>>. Accessed on 29 Nov 2021.

⁶ Operation License nr. 202/2009, issued on July 13th, 2009 by the Environmental Agency of Santa Catarina State (FATMA).

⁷ Available at: <http://www.planalto.gov.br/ccivil_03/leis/2002/L10438.htm>

micro-scale renewable electricity generation, which consumers can generate its own electricity and dispatch electricity surplus to the grid⁸.

The project also contributes for achieving the 37% emission reduction goal of Brazil up to 2025 year as established in its Intended Nationally Determined Contribution (INDC)⁹. The Brazilian INDC is under Law # 12,187 issued on 29-December-2009, which establishes the National Policy on Climate Change.

In conclusion, the project activity contributes to the national sustainable priorities of the Host Country.

⁸ ANEEL Resolution # 482 issued on 17-April-2012. Available at: <<http://www2.aneel.gov.br/cedoc/ren2012482.pdf>>

⁹ Available at:
<http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf>

Table 2: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
-	-	-	-	-	-

3 SAFEGUARDS

2.1 No Net Harm

As described in the registered PD, the Project Environmental Impact Study was prepared by Ambiental Consultoria e Planejamento Ltda. in September 1997 – Environmental impact assessment and environmental impact report (EIA/RIMA)¹⁰.

Considering the results of the EIA/RIMA conclusions, Environmental Basic Project (“PBA” from the Portuguese Projeto Básico Ambiental) was prepared in order to reduce the negative impacts and potentiate the positive ones identified during the project planning, construction and operation. The project PBA was prepared based on the Reference Term of the project EIA and conditionings established by the environmental agency.

Under PBA, the following plans have been implemented in order to reduce the impacts of the project construction, raised in the environmental study analysis:

I) Environmental control. It involves 17 (seventeen) programs, which includes: climates conditioning observations, water quality monitoring, monitoring and conservation of local fauna, reservoir cleaning, geological impacts monitoring, environmental control of the engineering works, degraded areas recuperation, ecological station implementation, terrestrial fauna monitoring and conservation, population resettlement, social communication, infrastructure improvement, workers training, public health control, support of the municipalities, landscape memory conservation, archeological rescue.

II) Expropriation. The expropriation plan was chosen to ensure a fair compensatory condition for the local community and a fair value to the areas involved in the project boundaries.

III) Multiple use of the reservoir. This plan involves the conservation and protection of the reservoir and other areas direct and indirect affected. The plan is divided in 2 (two) main programs: a) utilization program and; b) multiple use of the reservoir.

Besides of the above mentioned plans, there are several actions that are been implemented, which includes river flow maintenance, complementary environmental studies for the project monitoring, maintenance and monitoring of Ilha das Cotias (with hunters surveillance), treatment of the residues generated by the project construction, and others. All information related to the environmental programs and plans is presented in the project PBA (as mentioned below) and conditioning licenses. All information related to the licensing process is available with the project sponsors and the environmental agency of Santa Catarina State.

All programs are permanently maintained and monitored by a team Internal Environmental Management, and also by the IMA – Instituto do Meio Ambiente de Santa Catarina, through semi-annual

periodic reports, in addition to ANEEL as an agency regulator. The population, employees, Consortium members and other interested audiences are permanently informed through the maintenance of an extensive program of Social Communication, a strong relationship channel between the entrepreneur and the various audiences involved, who, through informational materials, program visits, meetings, among other actions, has disseminated information, and clarifying the community on the actions and measures adopted for their mitigation, as well as the facilitating the process of integrating the population to the new conditions created with the plant implantation.

Regarding environmental licenses, CONAMA Resolution # 237 dated 19/12/1997 establishes licenses required for the licensing process:

- The Preliminary License (“LP” from the Portuguese Licença Prévia);
- The Construction License (“LI” from the Portuguese Licença de Instalação);
- The Operating License (“LO” from the Portuguese Licença de Operação).

During the project implementation, all licenses mentioned above were issued by the environmental agency of Santa Catarina State. The current LO valid is LO # 4055/2012 issued on 31/05/2012 and it is valid for 96 months.

2.2 Local Stakeholder Consultation

There is no local nor national requirement to conduct the local stakeholder consultation prior to the project verification. According to national requirements¹¹, when applicable, public hearings shall be conducted before the project implementation and always conducted by a representative from the environmental agency responsible for the licensing process of the referred project.

In the case of the project activity, local stakeholder consultation was conducted before the project implementation through the public hearing held by the environmental agency in September 2002. Detailed description of the local stakeholder consultation is presented in the registered PD.

No major concerns were raised during the public hearing regarding the project implementation. All suggestions and comments raised during the licensing process were taken into account while executing the environmental plans and programs with the environmental agency supervision.

There were no comments, complaints or suggestions from local stakeholders prior to this project verification.

3.3 AFOLU-Specific Safeguards

Not applicable.

¹¹ CONAMA Resolution nr. 9/1987

4 IMPLEMENTATION STATUS

4.1 Implementation Status of the Project Activity

UHESP project started commercial operations on December 11th, 2009¹² (first generating unit). The second generating unit started commercial operations on January 19th, 2010¹³. The equipment and technology used in UHESP has been successfully applied to similar projects in Brazil and around the world.

As indicated in the Monitoring Report from the previous periods, the project has lower loss load than estimated due to an expansion of the headrace tunnel during the construction period. It causes a decrease in the pressure drop and, consequently, an increase in the net head, allowing the increase in the electricity generation and, consequently, in installed capacity and assured energy. Additionally, specifications of the equipment installed in the plant allowed this power increase.

However, no equipment has been modified or retrofitted since the plant became operational. Any equipment modification or retrofit has to be authorized by the Brazilian Power Regulatory Agency ("ANEEL" from the Portuguese Agência Nacional de Energia Elétrica) and shall be publicly available. Since no ANEEL authorizations are available, it can be demonstrated that equipment has not been modified. Additionally, there was no modification in the reservoir area. Equipment specifications are presented in Table 1 below.

Table 2 - Technical configuration of UHESP

Description		Salto Pilão HPP
Turbines	Type	Francis
	Quantity	2
	Power (MW)	97.65
	Nominal flow (m3/s)	55.5
	Water head (meters)	194
	Manufacturer	Voith Siemens
Generators	Type	Vertical-shaft
	Quantity	2
	Nominal Power (MVA)	106.6 (95.94 MW)
	Tension (kV)	13.8
	Frequency (Hz)	60
	Manufacturer	Voith Siemens

¹² As per ANEEL Ordinance #4,597 dated on 10/12/2009. Available at: <<http://www.aneel.gov.br/cedoc/dsp20094597.pdf>>

¹³ As per ANEEL Ordinance # 102 dated on 19/01/2010. Available at: <http://www.aneel.gov.br/cedoc/dsp2010102.pdf>

No special events - such as overhaul times, downtimes of equipment, exchange of equipment – occurred during the monitored period. Therefore, there were no events or situations that could have impacted the GHG emission reductions during the monitoring period.

4.2 Deviations

3.2.1 Methodology Deviations

Not applicable, since no methodology deviations are applied.

3.2.2 Project Description Deviations

Additionally, during the previous verification of the project the DOE has requested the revision of the PD in order to reflect changes occurred in the project design. The installed capacity of the project increased from 182.3 MW to 191.88 MW and assured energy increased from 106.7MW-ave to 109MW-ave and, later, to 114.1MW-ave due to underestimated historic of river flow rate.

Assured Energy	Legislation
106.7MW-ave	Concession contract # 15/2002
109MW-ave	MME Ordinance #35 issued on 22/05/2012
114.1MW-ave	MME Ordinance #178 issued on 3/05/2017

Detailed description on project changes is presented in CNEC Technical Report which was presented to ANEEL. ANEEL approved the project changes, including installed capacity, as can be seen in ANEEL Resolution #3,303 issued on 17/01/2012. Regarding the revision of assured energy, it was approved by the Brazilian Mines and Energy Ministry (“MME” from the Portuguese Ministério de Minas e Energia) as can be seen in MME Ordinance #35 issued on 22/05/2012 (109MW-ave) and MME Ordinance #178 issued on 03/05/2017 (114.1MW-ave).

All changes were previously approved in previous verifications.

4.3 Grouped Projects

Not applicable.

5 DATA AND PARAMETERS

5.1 Data and Parameters Available at Validation

All data and parameters for emission reduction calculation is monitored during the credit period. For details, please refer to the section 4.2 below.

5.2 Data and Parameters Monitored

Data / Parameter	EG _{facility,y}
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Data unit	MWh/year																																																											
Description	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y.																																																											
Source of data	Project sponsor and the power utility/CCEE.																																																											
Description of measurement methods and procedures to be applied	Electricity supplied by the project activity to the grid. Double checked by Project Sponsors internal control and documents from the power utility/CCEE. CCEE is a Brazilian government entity, which monitors the electricity on the national interconnected grid.																																																											
Frequency of monitoring/recording	Continuous measurement and at least monthly recording.																																																											
Value monitored	<table><tr><th rowspan="2">Month</th><th colspan="3">EG_{facility,y}</th></tr><tr><th>2018</th><th>2019</th><th>2020</th></tr><tr><td>January</td><td>112,563</td><td>83,166</td><td>21,142</td></tr><tr><td>February</td><td>71,115</td><td>95,588</td><td>-</td></tr><tr><td>March</td><td>82,722</td><td>105,222</td><td>-</td></tr><tr><td>April</td><td>72,615</td><td>77,756</td><td>-</td></tr><tr><td>May</td><td>24,823</td><td>83,824</td><td>-</td></tr><tr><td>June</td><td>33,875</td><td>87,909</td><td>-</td></tr><tr><td>July</td><td>30,501</td><td>39,928</td><td>-</td></tr><tr><td>August</td><td>36,108</td><td>14,955</td><td>-</td></tr><tr><td>September</td><td>107,187</td><td>29,893</td><td>-</td></tr><tr><td>October</td><td>112,248</td><td>67,909</td><td>-</td></tr><tr><td>November</td><td>65,131</td><td>98,679</td><td>-</td></tr><tr><td>December</td><td>59,303</td><td>32,864</td><td>-</td></tr><tr><td>TOTAL</td><td>808,231</td><td>817,693</td><td>21,420</td></tr></table>	Month	EG _{facility,y}			2018	2019	2020	January	112,563	83,166	21,142	February	71,115	95,588	-	March	82,722	105,222	-	April	72,615	77,756	-	May	24,823	83,824	-	June	33,875	87,909	-	July	30,501	39,928	-	August	36,108	14,955	-	September	107,187	29,893	-	October	112,248	67,909	-	November	65,131	98,679	-	December	59,303	32,864	-	TOTAL	808,231	817,693	21,420
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December	59,303	32,864	-																																																									
TOTAL	808,231	817,693	21,420																																																									
Monitoring equipment	Electricity meters. There are six energy meters (principal and backup): 2 installed at the power plants and 4 installed at the local substation, which continuously monitor the electricity generated by the plant and delivered to the grid. Their specification is detailed below in section 5.3. Calibration follows recommendations of the Electric System National Operator. Electricity meter(s): <u>UG1 meter at substation</u> <table><tr><td>Description</td><td>Main meter</td><td>Backup meter</td></tr></table>	Description	Main meter	Backup meter																																																								
Description	Main meter	Backup meter																																																										

	Serial number	PT-0902A536-01	PT-0903A301-01
	Type	ION 8600	ION 8600
	Accuracy	0.2	0.2
	Calib. Date	14/04/2015	14/04/2015
	Calib.frequency	5 years	5 years
	UG2 meter at substation		
	Description	Main meter	Backup meter
	Serial number	PT-0903A335-01	PT-0903A346-01
	Type	ION 8600	ION 8600
	Accuracy	0.2	0.2
	Calib. Date	14/04/2015	14/04/2015
	Calib.frequency	5 years	5 years
	Meter at power plants:		
	Description	Generator 1	Generator 2
	Serial number	PT-0812A276-01	PT-0811A790-01
	Type	ION 8600	ION 8600
	Accuracy	0.2	0.2
	Calib. Date	14/04/2015	14/04/2015
	Calib.frequency	5 years	5 years
QA/QC procedures to be applied	Equipment used have by legal requirements extremely low level of uncertainty.		
Purpose of the data	Calculation of baseline emissions.		
Calculation method	Not applicable.		
Comments	-		

Data / Parameter	Cap _{PJ}
Data unit	W
Description	Installed capacity of the hydro power plant after the implementation of the project activity.
Source of data	Project site and official data source.
Description of measurement methods and procedures to be applied	Installed capacity determined by official entities and can be confirmed during on-site visit verifications.
Frequency of monitoring/recording	Yearly.
Value monitored	191,880,000

Monitoring equipment	Not applicable.
QA/QC procedures to be applied	Determined based on recognized standards with no possibility of uncertainty.
Purpose of the data	Calculation of project emissions.
Calculation method	Not applicable.
Comments	-

Data / Parameter	A _{PJ}
Data 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.
Source of data	Project site
Description of measurement methods and procedures to be applied	Water level measured with electronic devices and compared to topographical studies from the project design.
Frequency of monitoring/recording	Monthly measurement and recording.
Value monitored	150,000 <i>Despite being monitored monthly, all measurements did not exceed the value of 319m, which is the maximum value of the reservoir level for the 150 m² area to be maintained, based on Operating License nr. 4055/2012 issued on July 13th, 2009 by the Environmental Agency of Santa Catarina State (FATMA).</i>
Monitoring equipment	-
QA/QC procedures to be applied	Determined based on recognized standards with extremely low level of uncertainty.
Purpose of the data	Calculation of project emissions.
Calculation method	<i>Comparison between monitored water levels and reservoir studies of quota x volume x area curve</i>
Comments	<i>The project's reservoir area is determined from the value of the normal maximum water level of 319 m¹⁴.</i>

¹⁴ According to Environmental License n°4055/2012, the normal maximum water level in the reservoir is 319 m, and this value is monitored according to the methodology.

Data / Parameter	EF _{grid.CM.y}									
Data unit	tCO ₂ /MWh									
Description	Combined 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”.									
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/texto_geral/emissao_despacho.html									
Description of measurement methods and procedures to be applied	Since option C) for the calculation of the operating margin was chosen, this value is up-dated annually according to data from the Brazilian DNA and following the prescription of the emission factor tool.									
Frequency of monitoring/recording	-									
Value monitored	<table><tr><th>Period</th><th>EF_{grid.CM.y} (tCO₂e/MWh)</th></tr><tr><td>01-Jan-2018 – 31-Dec-2018</td><td>0.3242</td></tr><tr><td>01-Jan-2019 – 31 Dec 2019</td><td>0.3051</td></tr><tr><td>01-Jan-2020 – 18 Jan 2020</td><td>0.3396</td></tr></table>		Period	EF _{grid.CM.y} (tCO ₂ e/MWh)	01-Jan-2018 – 31-Dec-2018	0.3242	01-Jan-2019 – 31 Dec 2019	0.3051	01-Jan-2020 – 18 Jan 2020	0.3396
Period	EF _{grid.CM.y} (tCO ₂ e/MWh)									
01-Jan-2018 – 31-Dec-2018	0.3242									
01-Jan-2019 – 31 Dec 2019	0.3051									
01-Jan-2020 – 18 Jan 2020	0.3396									
Monitoring equipment	-									
QA/QC procedures to be applied	Official source of data.									
Purpose of the data	Calculation of baseline emissions.									
Calculation method	-									
Comments	-									

Data / Parameter	EF _{grid.OM.y}	
Data unit	tCO ₂ /MWh	
Description	Operating 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”.	
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/texto_geral/emissao_despacho.html	

Description of measurement methods and procedures to be applied	Option C) was chosen to calculate the operating margin. This option does not permit the ex-ante vintage for the calculation of the emission factor. Therefore, the emission factor is calculated ex-post applying the numbers provided by the Brazilian DNA.									
Frequency of monitoring/recording	Hourly and aggregated as appropriate.									
Value monitored	<table><tr><td>Period</td><td>EF_{grid.OM.y} (tCO₂e/MWh)</td></tr><tr><td>01-Jan-2018 – 31-Dec-2018</td><td>0.5114</td></tr><tr><td>01-Jan-2019 – 31 Dec 2019</td><td>0.5082</td></tr><tr><td>01-Jan-2020 – 18 Jan 2020</td><td>0.5813</td></tr></table>		Period	EF _{grid.OM.y} (tCO ₂ e/MWh)	01-Jan-2018 – 31-Dec-2018	0.5114	01-Jan-2019 – 31 Dec 2019	0.5082	01-Jan-2020 – 18 Jan 2020	0.5813
Period	EF _{grid.OM.y} (tCO ₂ e/MWh)									
01-Jan-2018 – 31-Dec-2018	0.5114									
01-Jan-2019 – 31 Dec 2019	0.5082									
01-Jan-2020 – 18 Jan 2020	0.5813									
Monitoring equipment	-									
QA/QC procedures to be applied	Official source of data.									
Purpose of the data	Calculation of baseline emissions.									
Calculation method	-									
Comments	-									

Data / Parameter	EF _{grid.BM.y}									
Data 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”.									
Source of data	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC). Information available at: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html .									
Description of measurement methods and procedures to be applied	Option 2 was chosen to calculate the build margin. Therefore, the emission factor is calculated ex-post applying the numbers provided by the Brazilian DNA. Numbers provided by the Brazilian DNA is applied during the project verification.									
Frequency of monitoring/recording	Yearly									
Value monitored	<table><tr><th>Period</th><th>EF_{grid.BM.y} (tCO₂e/MWh)</th></tr><tr><td>01-Jan-2018 – 31-Dec-2018</td><td>0.1370</td></tr><tr><td>01-Jan-2019 – 31 Dec 2019</td><td>0.1020</td></tr><tr><td>01-Jan-2020 – 18 Jan 2020</td><td>0.0979</td></tr></table>		Period	EF _{grid.BM.y} (tCO ₂ e/MWh)	01-Jan-2018 – 31-Dec-2018	0.1370	01-Jan-2019 – 31 Dec 2019	0.1020	01-Jan-2020 – 18 Jan 2020	0.0979
Period	EF _{grid.BM.y} (tCO ₂ e/MWh)									
01-Jan-2018 – 31-Dec-2018	0.1370									
01-Jan-2019 – 31 Dec 2019	0.1020									
01-Jan-2020 – 18 Jan 2020	0.0979									
Monitoring equipment	N/A									

QA/QC procedures to be applied	Official source of data.
Purpose of the data	Calculation of baseline emissions.
Calculation method	-
Comments	-

5.3 Monitoring Plan

The project sponsor proceeded with the necessary measures for the power control and monitoring. Together with the information produced by both project sponsor and the power utility/Electric Energy Commercialization Chamber (CCEE), it is possible to monitor the power generation of the project (in MWh/year). CCEE makes feasible and regulates the electricity energy commercialization in Brazil.

There are six energy meters (principal and backup) specified by CCEE: 1 principal meter installed at each one of the generating units (total of 2 principal meters), which measure the gross energy, and 4 meters (2 principal meters and 2 backup meters) installed at the local substation, which measure the net energy. CCEE has on-line access to the energy readings from meters located at the substation.

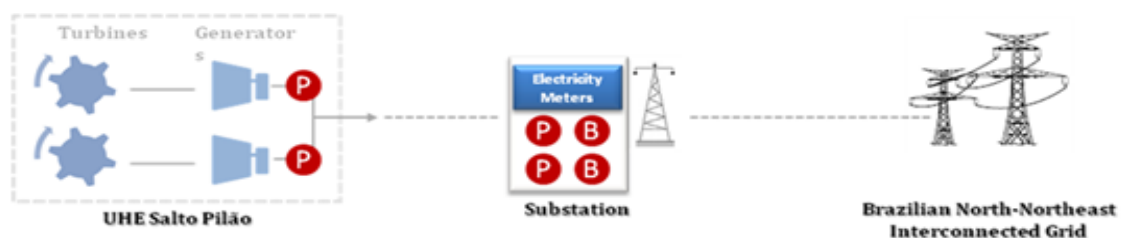
Energy data is measured by the meters in real time. Monthly, consolidations are made for payment purposes. Cross check is made between reports from CCEE/power utility and power plant. However, energy data from meters located at the power plant is higher than data from meters at the substation, considering transmission losses from the power plant to the substation.

The table below presents the meters description used at UHE Salto Pilão.

Table 3 - Meters description

Model	Manufacturer	Quantity	Location
ION 8600B	Schneider Electric	2	Power plant
ION 8600A		4	Substation

The diagram below presents the relevant monitoring points:



Legend:
P Principal Meter
B Backup Meter

Figure 3 - Diagram of the relevant monitoring points

According to updated ONS procedures¹⁵ valid on 01/01/2017 onwards, energy meter calibration shall be conducted following the necessary requirements and the established calibration frequency.

The following table presents the dates in which the meters were calibrated according to calibration certificates. All of the meters possess a precision class D (0.2% accuracy class).

Table 4 - Calibration dates of the energy meters

Location		Number	Calibration Dates	
			Date	Reference
Power Plant	Principal	PT-0812A276-01 installed on 17/04/2013	14/04/2015	CC-0082-15
	Principal	PT-0811A790-01	22/05/2015	CC-0081-15
Substation	Principal	PT-0902A536-01	14/04/2015	CC-0085-15
	Backup	PT-0903A301-01	14/04/2015	CC-0087-15
	Principal	PT-0903A335-01	14/04/2015	CC-0084-15
	Backup	PT-0903A346-01	14/04/2015	CC-0086-15

Considering the 5-year period for calibration frequency of energy meters located at the substation (which measures net electricity), the period covered by the last calibration is until 13/04/2020, which satisfies the monitoring period.

Electricity from CCEE/power utility reports is considered for emission reduction purposes. Therefore, these monthly reports were available during the project verification (estimated to happen yearly) as well as the calibration certificates from meters involved in the project activity. It is important to mention that the measurement of the electricity generation is done automatically by meters (principal and back-up) and it is controlled and stored by CCEE. Through CCEE system, the O&M team has access to the electricity generation data whenever necessary.

Salto Pilão Consortium is responsible for the maintenance of the monitoring equipments, 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. Salto Pilão Consortium 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.

The chart below represents Salto Pilão Consortium organizational structure.

¹⁵ ONS procedures. "Sub-module 12.3 Maintenance of the metering system for invoicing" (in a free translation from the Portuguese Submódulo 12.3. Manutenção do sistema de medição para faturamento). Available at ONS's website: <<http://ons.org.br/pt/paginas/sobre-o-ons/procedimentos-de-rede/vigentes>>

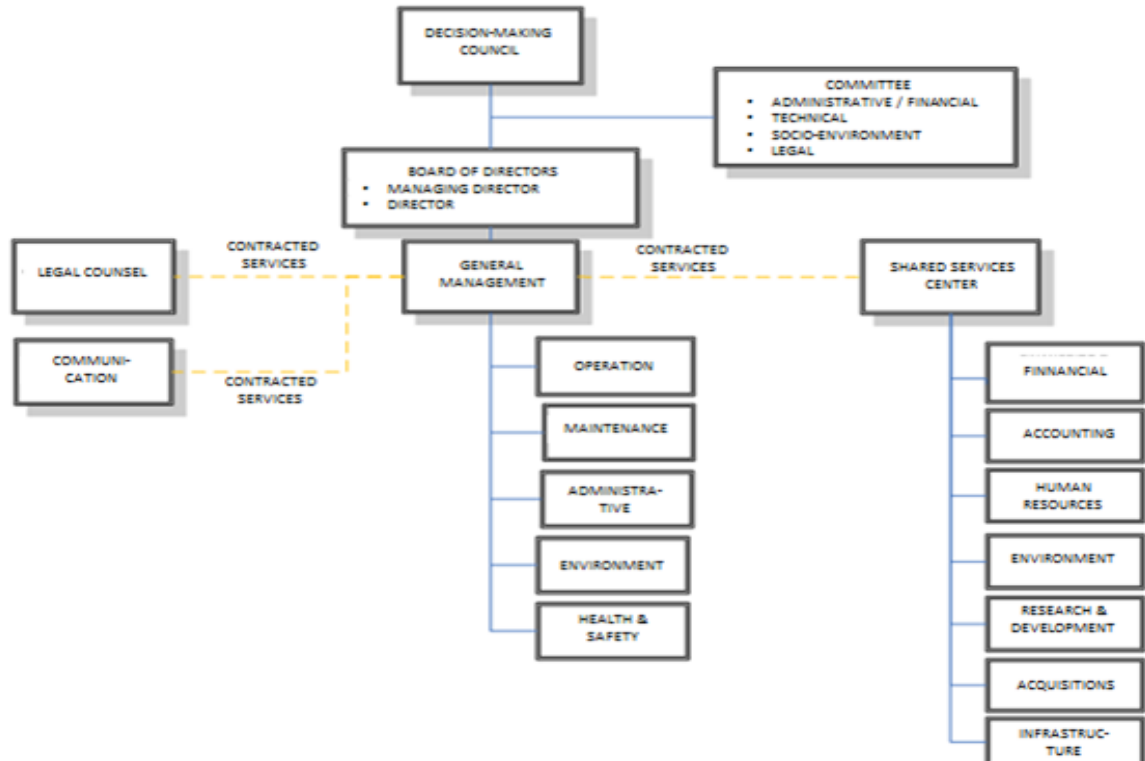


Figure 4 - Salto Pilão Consortium organizational structure

It is noteworthy that the directors of Salto Pilão Consortium, as well as those responsible for O&M indicated above and directly involved in the activities, have over 30 years of experience in the Brazilian electricity sector, with extensive qualification and have worked on several projects in Brazil and abroad.

Furthermore, all employees of the plant undergo periodic training and recycling process, which includes all training provided in the safety of the work force in Brazil. The plant operators also have specific training and accreditation to meet the requirements of the Brazilian Power Regulatory Agency (ANEEL). Additionally, since 2012, Salto Pilão has the ISO 9001:2008 certification.

In addition, the Brazilian Power Regulatory Agency (ANEEL) can visit the plant to inspect the operation and maintenance of the facility assuring that project sponsors are carrying out the necessary procedures for the project operation.

Salto Pilão Consortium has hired expert companies to execute their environmental programs. After the beginning of the commercial operations, renovation of degraded areas and of permanent preservation areas are being carried out according to the regulations of the environmental agencies, through a team of environment experts, who are also monitoring the compliance with the environmental agencies' regulations. Studies done during the design phase of the project activities have shown the environmental impacts and the interference on the social development in the region of the plant, indicating the mitigation measures adopted during the construction phase. These measures have been taken seriously. Data about environmental impact are being archived by the hydropower plant and the environmental agency.

6 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

6.1 Baseline Emissions

Emission reductions (ER_y)

According to the selected approved methodology ACM0002, emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \text{Equation 1}$$

Where:

ER_y	=	Emission reductions in year y (tCO ₂ e/yr);
BE_y	=	Baseline emissions in year y (tCO ₂ /yr);
PE_y	=	Project emissions in year y (tCO ₂ e/yr).

Baseline emissions (BE_y)

Baseline emissions are calculated using the annual electricity dispatched to the grid ($EG_{\text{facility},y}$) times the CO₂ baseline emission factor (EF_y), as follows:

$$BE_y = EG_{PJ,y} \cdot EF_{\text{grid},CM,y} \quad \text{Equation 2}$$

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);
$EF_{\text{grid},CM,y}$	=	Combined margin CO ₂ emission factor for grid connected power generation in year y calculated using the latest version of the “ <i>Tool to calculate the emission factor for an electricity system</i> ” (tCO ₂ /MWh).

For Greenfield projects installed at a site where no electricity generation occurred previously, as it is the case of the proposed project activity, the calculation of $EG_{PJ,y}$ is as follows:

$$EG_{PJ,y} = EG_{\text{facility},y} \quad \text{Equation 3}$$

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 generation of the project delivered to the grid ($EG_{facility,y}$)

The period of this project VCS verification is from January 1st 2018 to January 18th, 2020. The net energy produced is made available by the CCEE, for the calculation of VCUs. Energy exported to the grid in the above mentioned period is as follows:

Table 5 - Energy exported to the grid during the monitored period (in MWh)

Month	2018	2019	2020
January	112,563	83,166	21,420
February	71,155	95,588	-
March	82,722	105,222	-
April	72,615	77,756	-
May	24,823	83,824	-
June	33,875	87,909	-
July	30,501	39,928	-
August	36,108	14,955	-
September	107,187	29,893	-
October	112,248	67,909	-
November	65,131	98,679	-
December	59,303	32,864	-
Total	808,231	817,693	21,420

CO₂ emission factor of the grid (EF_y)

The CO₂ emission factor of the grid is the result of a weighted average of two emission factors pertaining to the electricity system: the “operating margin” (OM) and the “build margin” (BM). In the case of this project activity, parameters were calculated in accordance with the “Tool to calculate the emission factor for an electricity system” and were determined *ex-post*, as presented in the registered PD.

The Brazilian DNA made available the emission factor calculation based on information of the grid power plants only. More information of the methods applied can be obtained in the DNA’s website (https://antigo.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html)

Considering 0.5 as the weights for OM and BM emission factors available for renewable energy projects, excluding solar and wind power projects, the CO₂ emission factors considered in this monitoring period are as follows:

Table 6 – The CO₂ emission factor of the grid (in tCO₂e/MWh)

Year	EF _{grid.OM.y}	EF _{grid.BM.y}	EF _{grid.CM.y}
2018	0.5114	0.1370	0.3242
2019	0.5082	0.1020	0.3051
2020	0.5813	0.0979	0.3396

Considering Equation 2, the baseline emissions are as follow:

Table 7 – Baseline emissions during the monitored period (in tCO₂e)

Month	2018	2019	2020
January	36,495	25,376	7,275
February	23,069	29,166	-
March	26,820	32,105	-
April	23,543	23,725	-
May	8,048	25,576	-
June	10,983	26,823	-
July	9,889	12,183	-
August	11,707	4,563	-
September	34,752	9,121	-
October	36,392	20,720	-
November	21,117	30,109	-
December	19,227	10,028	-
Total	262,040	249,495	7,275

6.2 Project Emissions

New hydroelectric power projects resulting in new reservoirs, shall account for CH₄ and CO₂ emissions from reservoirs, estimated as follows:

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

$$PE_y = \frac{EF_{Res} \times TEG_y}{1000} \quad \text{Equation 4}$$

Where:

PE_y = Emission from reservoir expressed as tCO₂e/year;

EF_{Res} = Default emission factor for emissions from reservoirs, and the default value as per EB23 is 90 Kg CO₂e/MWh;

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

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

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \text{Equation 5}$$

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 reservoir 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 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.

For Salto Pilão HPP:

Capacity of the project = 191.89 MW

Reservoir area = 0.15 km^2

Power density = $191.88 / 0.15 = 1,279.20 \text{ W/m}^2$, so $PE_y = 0$.

6.3 Leakage

There is no leakage emissions involved in the project.

6.4 Net GHG Emission Reductions and Removals

Since there are no project emissions or leakage involved in the project activity, emission reductions are equal to baseline emissions. i.e. $ER_y = BE_y$.

Table 8 – Net GHG emission reductions or removals in (tCO_2e)

Year	Baseline emissions or	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or
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	removals (tCO ₂ e)			removals (tCO ₂ e)
2018	262,040	0.0	0.0	262,040
2019	249,495	0.0	0.0	249,495
2020	7,275	0.0	0.0	7,275
Total	518,810	0.0	0.0	518,810