2ND VERIFICATION

FOZ DO CHAPECÓ

Document Prepared by Carbotrader

carbotrader@carbotrader.com

Project Title	Foz do Chapecó
Version	*3.1*
Report ID	*Foz02*
Date of Issue	*10--January-2021*
Project ID	*896*
Monitoring Period	*01-July-2012 to 14-October-2020*
Prepared By	*Carbotrader Assessoria e Consultoria em Energia EIRELI*
Contact	*190, St Cap. Cassiano Ricardo de Toledo, Jundiai City, Sao Paulo State, Brazil, ZIP 13201-840, Phone: +55 11 4522-7180, carbotrader@carbotrader.com, www.carbotrader.com*

CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project activity consists on the supply of clean hydroelectric energy to the Brazilian National Interconnected System (SIN) through the implantation and operation of Hydro Power Plant (HPP) Foz do Chapecó, located in the Southern Region of Brazil, between the cities of Águas de Chapecó, state of Santa Catarina (SC) and Alpestre, state of Rio Grande do Sul (RS), with an installed capacity of 855 MW (4 generation units with nominal power of 213.75 MW each and 4 francis turbines with 217.14 MW each), using a small reservoir, with low environmental impact related to its installed capacity.

Foz do Chapecó Hydro Power Plant generates electricity through clean and renewable source and it contributes to attend the growing demand for electricity in Brazil, due to the country's economical and population growth, contributing, thus, to the environmental, social and economical sustainability, by increasing the participation of clean and renewable energy in relation to the country's total consumption of electricity.

Baseline scenario establishes that electricity delivered to the grid by the project activity would have been generated otherwise by the operation of a grid-connected power plant and by the addition of new generating sources, as reflected in the combined margin (CM) calculations described in the "Tool to calculate the emission factor for an electricity system" (Version 2.2.1). This Tool is from the Clean Development Mechanism (CDM).

The alternative scenarios to the project activity are two situations which reflect the calculation of the combined margin of baseline scenario: (i) the continuity of the present scenario, with electricity generation happening according to the current generation composition of the National Interconnected System, more specifically of the South Subsystem and (ii) the construction of a new mineral coal thermoelectric power plant.

The power plant started the construction on 05/12/2006 has acquired the operation license on 25/08/2010 and started operation on 14/10/2010.

The exploitation concession permits the operation until 06/11/2036.

The total GHG emissions reductions or removals generated in this monitoring period is 12,450,836 tCO_2e.

1.2 Sectoral Scope and Project Type

Foz do Chapecó Project fits in the category of sectoral scope 1 - Energy (renewable/non-renewable) and it is not a grouped project.

1.3 Project Proponent

Organization name	Foz do Chapecó Energia S.A.
Contact person	Peter Eric Volf
Title	Director
Address	203, St. Germano Wendhausen, Centro Executivo Beiramar, Room 401 Florianopolis City – Santa Catarina State, Brazil - ZIP 88015-460
Telephone	+55 48 3029-5057
Email	pvolf@fozdochapeco.com.br

Organization name	Enerbio Consultoria LTDA - ME
Contact person	Eduardo Baltar de Souza Leão
Title	Director
Address	Germano Petersen Junior, 101/706 Porto Alegre City – Rio Grande do Sul State, Brazil ZIP 90540-140
Telephone	55 51 3392-1500
Email	eduardo@enerbio-rs.com

1.4 Other Entities Involved in the Project

Organization name	Carbotrader Assessoria e Consultoria em Energia EIRELI
Role in the Project	PD and MR Consultant

Contact person	Arthur Moraes
Title	Director
Address	190, St Cap. Cassiano Ricardo de Toledo, Jundiai City, Sao Paulo State, Brazil, ZIP 13201-840
Telephone	+55 11 4522-7180
Email	carbotrader@carbotrader.com

1.5 Project Start Date

14/10/2010 (Operation Starting Date of the first generation unit).

1.6 Project Crediting Period

The Project crediting period is 14/10/2010 to 14/10/2020. The total number of years is 10 years renewed at most two times.

1.7 Project Location

HPP Foz do Chapecó is located in Uruguay River, between the municipalities of Águas de Chapecó/SC and Alpestre/RS, in Brazil. The geographic coordinates are: Latitude 27° 08' 24" South and Longitude of 53° 02' 36" West1.

1.8 Title and Reference of Methodology

- Version 13.0.0 of consolidated baseline and monitoring methodology ACM0002 - Methodology Consolidated for grid-connected electricity generation from renewable sources.

  Link:

  https://cdm.unfccc.int/methodologies/DB/XP2LKUSA61DKUQC0PIWPGWDN8ED5PG

- TOOL 07: Version 2.2.1 of "Tool to calculate the emission factor for an electricity system".

link: https://cdm.unfccc.int/Reference/tools/index.html

1.9 Participation under other GHG Programs

Not applicable. No participation under other GHG Programs.

[1] Available at http://www.aneel.gov.br/cedoc/dsp2007911.pdf

1.10 Other Forms of Credit

Not applicable.

Project not included in emissions trading program or any other mechanism that includes GHG allowance trading. Also the project has not sought or received another form of GHG-related environmental credit, including renewable energy certificates, during this monitoring period.

1.11 Sustainable Development

The participants of the project recognize that this Project activity is helping Brazil to fulfil its goals of promoting sustainable development due to the following reasons.

- Contributes to local environmental sustainability, since it decreases the dependence on fossil fuels, thus improving air quality;

- Contributes towards better working conditions and increases employment opportunities in the area where the project is located;

- Contributes towards better revenue distribution since it assists the regional/local economic Development;

- Contributes to the development of technological capacity because most of the equipment of the project will be manufactured inside Brazil, consolidating the technology in the country.

The project lifetime for Foz do Chapecó hydroelectric project is 35 years, according to the contract exploitation concession.

2 SAFEGUARDS

2.1 No Net Harm

The EIA (from portuguese *Estudo de Impacto Ambiental, Environmental Impact Studies*) and RIMA (from portuguese *Relatório de Impacto Ambiental, Environmental Impact Document*) developed for the Project Activity highlight the environmental impacts of the hydroelectric plant and the actions to minimize the adverse impacts. The environment modifications described in the EIA and RIMA will be object of specific actions, of responsibility of the entrepreneur, that aim at the correction or compensation of its negative effects, maximizing, on the other hand, its positive effects. Such actions are presented below, always related to the impacts that had determined its recommendation.

The Project Developer has been executing out of court amicable agreements with the people affected by the Project as actions for people resettlement. Those actions were planned together with local government and concerning local stakeholder's opinion. The objective of the

document set with local government, is define the line of behavior for the treatment of the questions related to the necessary services and actions to execute the resettlement program, aiming to minimize the negative effects, assuring that the impacted population are indemnified or resettled in a satisfactory and proper form, searching life quality and access to land, natural resources and services (drinking water and infrastructure), resulting in equal or better chances that this population had before its resettlement. The process will be done in participatory way and adopting procedures communication capable to clarify the affected population about the diverse stages of the resettlement process.

IMPACTS	PROGRAMS
Alteration of the Fluvial System	Limnology and Water Quality Monitoring
Water table elevation	Erosive Processes control
Alteration of water quality	Limnology and Water Quality Monitoring
Interference of Authorized Areas and Mineral Concessions with the Reservoir	Mineral Investigations
Start or acceleration of erosive processes	Erosive Processes control Recuperation of Degraded areas
Occurrence of Induced Earthquakes	Seismographic monitoring
Reduction of Biological diversity of Aquatic Ecosystems	Limnology and Water Quality Monitoring Ichthyofauna Monitoring Implantation of a Unit of Conservation and Protection of the Fauna and Flora
Alteration of the Structure of the Aquatic Fauna and of the Water Quality pry-Operational Phase	Limnology and Water Quality Monitoring. Ichthyofauna Monitoring
Alteration of the Structure of the Aquatic Fauna and of the Water Quality the Wadding Phase and the Operation of the Dam	Limnology and Water Quality Monitoring. Ichthyofauna Monitoring
Migratory routes detrimental	Limnology and Water Quality Monitoring. Ichthyofauna Monitoring
Removal of Current Vegetal Covering and Loss of Habitats	Ichthyofauna Monitoring Implantation of a Unit of Conservation and Protection of the Fauna and Flora
Increase of the Hunting	Implantation of a Unit of Conservation and Protection of the Fauna and Flora Environmental education and Social

	Communication
Generation of Population Expectation due to the Enterprise	Environmental education and Social Communication Population resettlement and reorganization of the remaining areas Reconstruction and improvement of Infra-structure
Change of the social cultural Behaviour Population Affected	Environmental education and Social Communication Support to resettled population Support to farming activities
Familiar Production Unit unstructured	Support to resettled population Support to farming activities
Archaeological sites interference	Heritage rescue
Healthcare amendment	Health
Amendment of the Labour Market	Health Support for Migrant Populations
Amendment of the Real Estate Market	Population Re-settlement and Re-organization of remaining areas Reconstruction and Infrastructure Improvements
Amendment of Market Goods and Regional Income and Municipal Collection	Population Re-settlement and re-organization of remaining areas Reconstruction and Infrastructure Improvements
Improvement of Transmission and Communication Systems	Reconstruction and Infrastructure Improvements
Traffic Intensification and Interference with the Road Infrastructure	Environmental Education and Social Communication Reconstruction and Infrastructure Improvements
Loss of Agricultural Production Areas	Support for Agricultural Activities
Compulsory Population Displacement	Population Re-settlement and re-organization of remaining areas Support for Migrant Populations Support for Agricultural Activities
Interference with fluvial passages	Reconstruction and infrastructure

	improvements
Interference with Social Infrastructure	Reconstruction and infrastructure improvements
Interference with Indigenous Communities	Monitoring of Indigenous populations

An extensive list of all mitigation actions to be implemented is included in the EIA.

2.2 Local Stakeholder Consultation

For During the environmental licensing process (from 13/12/2002), the Environmental Impact Report is presented to stakeholders and the stakeholders are invited to perform comments about the project. A public audience is performed coordinated by Environmental Agency. This process was performed by the entrepreneurs and comments are registered in the documents related to the licensing process[2]. The public audiences occur in the cities of Alpestre/RS and Chapecó/SC.

The company has the compromise of responding to 100% of the issues it receives from the public audiences, through meetings to debate the topic, official communication related to the issues and visit to the site related to the claim.

Even when the company does not agree with the issue or cannot attend the claim, the company try to clarify the issue and explain why could not address such issues.

It is noteworthy that the Agreement Term for Relocation of Affected Population was signed between Foz do Chapecó Energia,and Municipal Committee Negotiating. This document guides the procedures and benefits for local communities affected by the project. Several meeting with local communities happened to include the demands of the community and to express the benefits it looks for. The Agreement Term for Relocation of Affected Population consolidates the terms agreed by entrepreneur and the local community related to relocation of people.

The Global Stakeholder Consultation was held during the CDM Process. The project was included in the UNFCCC website at the link below in the period from 03/05/2010 to 05/06/2010.
http://cdm.unfccc.int/Projects/Validation/DB/RW0WDFRG71MV5E4EYN0TWHL46GK9F3/view.html

No comments were received about the project during this period.

[2] The minutes of meeting were provided to auditors.

The communication of Foz do Chapecó with stakeholders was based on specific plans for each stage of the project (construction and operation)[3]. During the construction phase, was prioritized communication "face to face" with meetings in affected communities, visits to affected families and the mayors of the municipalities around the hydroelectric.

The main objective was to clarify doubts and disclosure procedures and programs linked to the implementation of the plant and the relocation of the affected population. During this period, were also used tools and channels for the transmission of information of public interest: radio bulletins, publishing informational columns in newspapers of local circulation, production of books and instructional booklets for direct distribution in the affected communities.

Other materials were produced to meet the interests of shareholders and regulators as IBAMA, Ministry of Mines and Energy and ANEEL. Included in this case the monthly newsletter sent by the company to these organs and the various reports produced to provide updated information about the project. All channels and materials are being held by the company at the stage of operation of the project for ongoing communication with local people and other stakeholders. It is also maintained its commitment to meet the demands of meetings, hearings and communities of interest to clarify issues and receiving claims.

The company developed an intense communication dialogue with local communities and social movements. Several meetings were performed with the cities committees and Movement of Affected by Dams (From Portuguese *Movimento dos Atingidos por Barragem* – MAB). The meetings were conducted by representatives from the Government at most. This assured the democratic and transparent character of the plant implementation process

During the construction phase, there were two invasions to the plant. Both were peacefully negotiated with concessions on both sides. Otherwise, in other situations, there were registered peaceful demonstrations regarding the enterprise, which has always had its patterns of claims received by the company's board and its representatives discussed with the social movements.

All reported events resulted in meetings scheduled by the company with the Movement of Affected by Dams, and widely publicized by the media and accompanied by the leaders of the municipalities affected by the project. Foz do Chapecó also always remained available to the press to clarify issues that mobilize public opinion and providing information of interest to the press and their readers/viewers. Moreover, issues official statements during these occurrences to stand before society and reaffirm their willingness for dialogue and conflict resolution. All the actions taken by Foz do Chapecó are followed by environmental official entities and are in accordance with the applicable law. This can be evidenced by the license of operation issued by the environmental entity.

[3] Social Communication Program in the Environmental Basic Plan. Page 490/735.

During the ongoing plant operation the channels for stakeholders communication is permanently opened through: local office in the city, website with news from project activity and also e-mail and phone contacts available. Link: http://www.fozdochapeco.com.br/

Several programs and activities involving the local stakeholders has being provided during the project lifetime (as recently examples we have: Water Use Program in Erval Grande City on December 2019, Several press releases material (about sustainable and environmental programs) on local newspaper during 2020 year (due to the COVID 19 pandemic was not possible *in person* meetings or activities, etc). Reports and pictures are public available in the project owner' website.

Also there are programs that involves the local community, for example the "PACUERA program" that accepts local community participation through sustainability projects coming from them.

2.3 AFOLU-Specific Safeguards

Not applicable. Not AFOLU project.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity became fully operational on 12/03/2011 (4th generation unit started). After this date there aren´t any event that may impact the GHG emissions reductions or removals and monitoring.

3.2 Deviations

2.3.1 Methodology Deviations

Not applicable. No methodology deviation.

2.3.2 Project Description Deviations

Not applicable. No project description deviation.

3.3 Grouped Projects

Not applicable. Not grouped with other projects.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Cap_{bl}
Data unit	*W*
Description	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plant the value is zero.
Source of data	Project Site
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	Values based on technical specification. As HPP Foz do Chapecó is a new power plant (greenfiled), this value is 0 (zero).
Purpose of Data	Calculation of project emissions
Comments	-

Data / Parameter	A_{BL}
Data unit	m^2
Description	Provide 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 (Greenfield), this value is zero.
Source of data	Project site
Value applied	0
Justification of choice of data or description of measurement methods and procedures applied	As HPP Foz do Chapecó is a new power plant, this value is 0 (zero).
Purpose of Data	Calculation of project emissions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	Electricity Supplied to the Grid – Net Electricity ($EG_{facility,y}$)
Data unit	*MWh/yr*
Description	*Quantity of net electricity generation supplied by the project plant/unit to the grid in year y.*
Source of data	*Project Activity Site (Meters).*
Description of measurement methods	*The following parameters shall be measured:* *(i) The quantity of electricity supplied by the project plant/unit to*

and procedures to be applied	*the grid; and* *(ii) The quantity of electricity delivered to the project plant/unit from the grid* *Spreadsheets were used, obtained directly from the meters with information generated hourly, or according to what was programmed by CCEE (Câmara de Comercialização de Energia Elétrica/*Electric Power Commercialization Chamber*). Monthly, the information was checked with the generation spreadsheets available at the CCEE's website. Besides, information of generation can be checked by receipt of sales, if it is necessary to do so. The meters accuracy is 0.2% in accordance with applicable standards.*
Frequency of monitoring/recording	*Continuous measurement and at least monthly recording.*
Value monitored	2012 = 1,491,444.15 2013 = 4,130,870.35 2014 = 5,086,805.77 2015 = 5,387,312.07 2016 = 4,682,993.00 2017 = 3,376,820.00 2018 = 3,520,188.48 2019 = 3,709,080.36 2020 = 1,838,898.23
Monitoring equipment	The manufacturer is Schneider Electric, models ION8600 or ION8650, with accuracy class 0.2. The serial numbers of the main meters are described on Section 4.3 (table 1).
QA/QC procedures to be applied	The uncertainty level for these data is low. They are used to calculate the emission reductions. The electricity generated is monitored by the project participants and checked by spreadsheets available at the CCEE`s Website (information comparison between operation data and CCEE reports).
Purpose of the data	Calculation of baseline emissions
Calculation method	The datas are promptly available through electronic data acquisition. Also public available in the CCEE website.
Comments	

Data / Parameter	$EF_{grid,CM,y}$ - Combined Margin CO_2 Emission Factor

Data unit	tCO_2/MWh
Description	The 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". The combined margin CO_2 emission factor used on Foz do Chapecó Project was calculated based on data supplied for the National Interconnected System by Brazilian DNA.
Source of data	Ex-post emission factor was calculated by project participants with data supplied by MCTI with ONS data. The variables $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$, necessary for $EF_{grid,CM,y}$ calculation, was also monitored and calculated by MCTI and ONS, through the Dispatch Data of the National Interconnected System.
Description of measurement methods and procedures to be applied	As described in the most recent version of the "Tool to calculate the emission factor for an electricity system".
Frequency of monitoring/recording	Yearly
Value monitored	$EF_{grid,CM,y}$ 2012 = 0.3895 $EF_{grid,CM,y}$ 2013 = 0.4322 $EF_{grid,CM,y}$ 2014 = 0.4400 $EF_{grid,CM,y}$ 2015 = 0.4075 $EF_{grid,CM,y}$ 2016 = 0.3904 $EF_{grid,CM,y}$ 2017 = 0.2955 $EF_{grid,CM,y}$ 2018 = 0.3380 $EF_{grid,CM,y}$ 2019 = 0.3100 $EF_{grid,CM,y}$ 2020 = 0.2638
Monitoring equipment	As per the "tool to calculate the emission factor for an electricity system".
QA/QC procedures to be applied	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 the data	Calculation of baseline emissions
Calculation method	As per the "tool to calculate the emission factor for an electricity system". Dispatch Data Analysis OM is the Operation Margin Emission Factor method used and the build margin emission factor is updated annually. Both Operating Margin Emission Factor and Build Margin

	Emission factor are supplied by MCTI. The combined margin emission factor considers the default value of 0.5 for each Emission factor as recommended by the "Tool to calculate the emission factor for an electricity system".
Comments	

Data / Parameter	$EF_{grid,BM,y}$
Data unit	tCO_2/MWh
Description	CO_2 Build Margin emission factor of the grid, in a year *y*
Source of data	Based on data provided by DNA (Designated National Authority).
Description of measurement methods and procedures to be applied	According procedures established by the most recent version of "Tool to calculate the emission factor for an electricity system".
Frequency of monitoring/recording	Yearly
Value monitored	$EF_{grid,BM,y}$ 2012 = 0.2010 $EF_{grid,BM,y}$ 2013 = 0.2713 $EF_{grid,BM,y}$ 2014 = 0.2963 $EF_{grid,BM,y}$ 2015 = 0.2553 $EF_{grid,BM,y}$ 2016 = 0.1581 $EF_{grid,BM,y}$ 2017 = 0.0028 $EF_{grid,BM,y}$ 2018 = 0.1370 $EF_{grid,BM,y}$ 2019 = 0.1020 $EF_{grid,BM,y}$ 2020 = 0.0979
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	Calculation of baseline emissions.
Calculation method	-
Comments	-

Data / Parameter	$EF_{grid,OM-DD,y}$
Data unit	tCO_2/MWh

Description	CO_2 Operating Margin emission factor of the grid, in a year *y*
Source of data	Data provided by DNA (Designated National Authority) to the year *y*.
Description of measurement methods and procedures to be applied	According procedures established by the most recent version of "Tool to calculate the emission factor for an electricity system".
Frequency of monitoring/recording	Yearly
Value monitored	$EF_{grid,OM,y}$ 2012 = 0.5779 $EF_{grid,OM,y}$ 2013 = 0.5932 $EF_{grid,OM,y}$ 2014 = 0.5837 $EF_{grid,OM,y}$ 2015 = 0.5597 $EF_{grid,OM,y}$ 2016 = 0.6228 $EF_{grid,OM,y}$ 2017 = 0.5882 $EF_{grid,OM,y}$ 2018 = 0.5390 $EF_{grid,OM,y}$ 2019 = 0.5181 $EF_{grid,OM,y}$ 2020 = 0.4296
Monitoring equipment	
QA/QC procedures to be applied	This data will be annually updated to be applied in ex-post calculation of the Emission Factor of Combined Margin
Purpose of the data	Calculation of baseline emissions.
Calculation method	-
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
Description of measurement methods and procedures to be	The installed capacity is monitored annually by ANEEL, environment regulators or by sub-hired companies, according recognized standards. It will be monitored yearly.

applied	
Frequency of monitoring/recording	Yearly
Value monitored	855,000,000
Monitoring equipment	-
QA/QC procedures to be applied	The uncertainty level for these data is low. The installed capacity is determined on the project's beginning and it will be monitored by the Regulator Agent.
Purpose of the data	Calculation of project emissions
Calculation method	The total of 4 generators capacity (nominal power of 213.75 MW each generator)
Comments	

Data / Parameter	A_{pj}
Data unit	m^2
Description	*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.*
Source of data	*Project Site*
Description of measurement methods and procedures to be applied	Measured from topographical surveys and satellite pictures. The reservoir area is also controlled by Brazilian Environmental Agency (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA) through the operation license. The reservoir area is defined by the engineering project and it would just change due to modifications in the project. To promote any changes in the reservoir area is necessary to have approvals by Environmental Agency. Therefore, the Operation License is an evidence for reservoir area.
Frequency of monitoring/recording	Yearly
Value monitored	2012 = 80,020,000 m^2 2013 =80,020,000 m^2 2014 =80,020,000 m^2 2015 =80,020,000 m^2 2016 =80,020,000 m^2 2017 =80,020,000 m^2 2018 =80,020,000 m^2

	2019 =80,020,000 m^2 2020 =80,020,000 m^2 The area of the reservoir of HPP Foz do Chapecó is 79,930,000 m^2 from the "principal reservoir"[4] + 90,000 m^2 from the "passage way"[5]. Total of 80,020,000 m^2.
Monitoring equipment	Topographical measurement to measure the area of the reservoir.
QA/QC procedures to be applied	The uncertainty level for these data is low. The reservoir area is monitored by environment regulators.
Purpose of the data	Calculation of project emissions
Calculation method	The flooded area is demarcated by pickets. Each picket has precise geographical coordinates which generate a faithful reference to the area flooded. After the fulfillment of the reservoir, the water levels will get the base of each picket that will be monitored systematically during the plants operation. The level of water near to the pickets assures that the area of the reservoir is not changed.
Comments	*The minimum operational height of UHE Foz do Chapecó is 264 m and the maximum operational height is 265 m.* *Due to the above and characteristic of the point where the hydroelectric dam is located, the reservoir area does not change, always remaining (perennially) as a full river. Therefore, the area values remain constant during (continuous) monitoring. Through Google Earth itself (point "UHE Fóz do Chapecó) it is possible to check the above.* *Additionally, according to Ibama's Environmental License, it is necessary to:* *"2.1.18. Program 18 (PA-18): Inspection of the Reservoir and its Surroundings"* *Based on the above, the environmental agency already annually inspects the area of the reservoir and its surroundings (APP, land, bathymetry, etc).*

[4] ANEEL's Dispatch 911 of 30/03/2007 for flooded reservoir area of 79.93 km^2

[5] Consolidated Basic Engineering Project prepared by CENEC Engenharia S.A. "HFC-RT1P-GEG00-1001-0"

4.3 Monitoring Plan

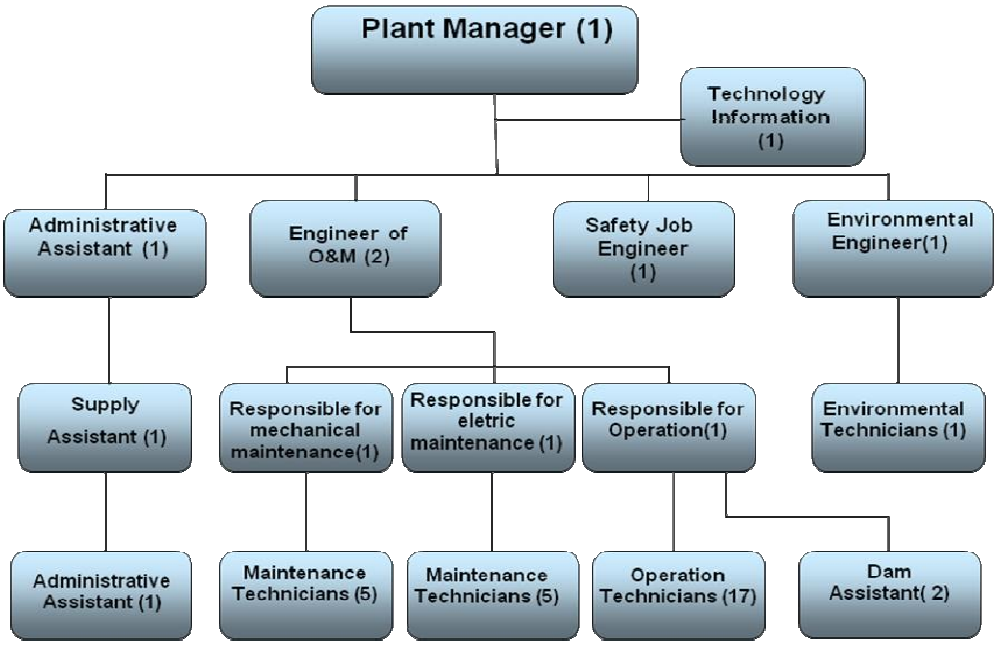
Monitoring has the objective of measuring the emission reductions achieved by the project. To elaborate the monitoring plan, it was followed the Monitoring Methodology present in consolidated baseline methodology for grid-connected electricity generation from renewable sources ACM0002, version 13.0.0 (methodology applied to the project).

The main parameters controlled are:

- Net Electricity Supplied to the Grid (MWh);
- Emission Factor for Electricity Generation Connected to the Brazilian Interconnected Grid (tCO_2e/MWh);
- Power plant capacity (MW) and flooded reservoir area (m^2).

HPP Foz do Chapecó Operation and Maintenance Manager is responsible for the operation and maintenance activities of the plant and for the activities of consolidation and analysis of gross and net electricity. Measurements activities are carried out by the operators of the Technology Information team.

The organizational structure of the company is presented below:



Each generator unit has three measurement instruments, Model ION8600/8650 – Schneider, with accuracy class 0,2. One of them is located in the Powerhouse and it measures the gross electricity generated by the unit and the other two, called "*Principal*" (Main) and "*Retaguarda*" (Backup), are located in the substation with the objective of measuring net electricity (grid connection point).

Daily, operators of Foz do Chapecó operation team collects electricity generation data from each meter. This activity occurs online with the software. Information of net electricity supplied by the principal meters is consolidated in one spreadsheet.

Data of net electricity generation may be confronted with the information present in the website of the CCEE (Câmara de Comercialização de Energia Elétrica/ Electric Power Commercialization Chamber)

(CCEE - Entity responsible for measurements, accounting and settlement on Brazilian electric energy market).

The emission factor for power generation connected to Brazilian National Interconnected System was made available by Ministry of Science, Technology and Innovation (MCTI) with data of National System Operator, ONS. The variables $EF_{grid,OM,y}$ and $EF_{grid,BM,y}$ were calculated and monitored by the **ER (Emission reduction) consultant company** through the dispatch data of National Interconnected System. Emission reductions calculations are carried out by ER team.

ONS Grid Procedures (Sub-module 12.3) defines the calibration frequency and other maintenance procedures. By the time of completion of this document, the frequency of calibration is a maximum of five years, but in the case of any changes occurred in the ONS Grid Procedures, the project owners shall follow the rules from the relevant sector organizations (e.g. ONS, ANEEL, CCEE).

All eight meters (main and backup for each generation set) were calibrated each two years.

Table 1: Calibration Date (Main and Backup meters)

Generation Unit	Meter Serial Number	Calibration Datas				
GEU1M	PT-0902A259-01	29/02/2012	25/02/2014	23/02/2016	06/12/2017	03/12/2019
GEU1B	PT-0902A301-01	29/02/2012	25/02/2014	Cancelled[6]	Cancelled	Cancelled
GEU2M	PT-0907A212-01	29/02/2012	25/02/2014	23/02/2016	Cancelled[7]	Cancelled
GEU2B	PT-0810A884-01	29/02/2012	25/02/2014	23/02/2016	05/12/2017	03/12/2019
GEU3M	PT-0907A215-01	29/02/2012	25/02/2014	23/02/2016	Cancelled[8]	Cancelled
GEU3B	PT-0907A574-01	29/02/2012	26/02/2014	23/02/2016	06/12/2017	03/12/2019
GEU4M	PT-0902A220-01	29/02/2012	25/02/2014	23/02/2016	06/12/2017	03/12/2019
GEU4B	PT-0907A571-01	29/02/2012	26/02/2014	23/02/2016	06/12/2017	03/12/2019
GEU1B	PT-0910A474-01			23/02/2016	Cancelled[9]	
GEU1B	MW-1603A689-02				07/12/2017	03/12/2019
GEU2M	MW-1511A170-02				06/02/2017	03/12/2019
GEU3M	MW-1511A526-02				06/02/2017	03/12/2019

In HPP Foz do Chapecó, there is a Measurement Billing System (SMF- from the Portuguese *Sistema de Medição de Faturamento*) according the technical specifications defined by ONS Grid Procedures. The

[6] "Cancelled" status since the meter was exchanged on 23/02/2016 by "PT-0910A474-01" (no more operational since this date)

[7] "Cancelled" status since the meter was exchanged on 29/02/2016 by "MW-1511A170-02" (no more operational since this date)

[8] "Cancelled" status since the meter was exchanged on 29/02/2016 by "MW-1511A526-02" (no more operational since this date)

[9] "Cancelled" status since the meter was exchanged on 07/12/2017 by MW-1603A689-02 (no more operational since this date)

communication of this SMF with CCEE occurs directly through a VPN (Virtual Private Network) and, this way, SCDE (*Sistema de Coleta de Dados de Energia Elétrica/* Electric Power Data Collection System) has direct access to the mass memory of the electricity meters.

Monthly, HPP Foz do Chapecó operators collect in the electricity meters mass memory, gross and net hourly generation data of generation unit referring to the previous month. These data are compiled in a unique spreadsheet which is the HPP internal control generation spreadsheet for the referred month under analysis.

Information present in internal control generation spreadsheet was confronted with SCDE spreadsheet. SCDE spreadsheets provide electricity generation values identical to the values of the HPP internal control generation spreadsheet. However, for emission reductions calculation, it was used electricity generation data of CCEE General Measurement Report, present in the CCEE website. This data is consisted by the net electricity generation minus losses, setting, therefore, a more conservative value.

Both generation information, internally generated and through CCEE website, are electronically stored by the Operation and Maintenance Manager.

ER consultant cross-checks internal control generation spreadsheet with electricity generation data supplied by CCEE. If non-conformities are identified, an email is sent to Operation and Maintenance Foz do Chapecó Manager. The non-conformity is investigated and if the problem is in the internal control, the spreadsheet is corrected.

It is important to say that electricity generation information impacts directly the revenues of Foz do Chapecó once electricity is the main product of the project. Therefore, a straight control is performed about this information.

The emission reduction calculation is done by ER analyst and revised by ER´s manager.

All data collected as part of the monitoring will be archived and be kept for at least 2 years after the end of the last crediting period.

HPP Foz do Chapecó has achieved ISO 14001, ISO 9001 and ISO 45001 certificates.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

To monitor Baseline emissions is necessary to monitor also the electricity supplied to the grid (EGy) and the Combined Margin Emission Factor and its components.

The baseline methodology ACM0002, version 13.0.0, establishes that baseline emissions include only CO_2 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 emission is calculated as follows:

$$BE_y = EG_{PJ,y} * EF_{grid,CM,y} \qquad \textbf{Equation 1}$$

Where:

BE_y = Baseline Emission 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).

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

For baseline emission factor calculation, the six steps below should be followed:

STEP 1. Identify the relevant electricity systems;

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional);

STEP 3. Select a method to determine the operating margin (OM);

STEP 4. Calculate the operating margin emission factor according to the selected method;

STEP 5. Calculate the build margin (BM) emission factor;

STEP 6. Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electricity systems

Considering the stated in the "Tool to calculate the emission factor for an electricity system[10]" and the fact that Brazilian DNA has published the Resolution nº 8 issued on May 26th, 2008, which defines the **Brazilian Interconnected Grid** as a single system that covers all the five macro-geographical regions of the country (North, Northeast, South, Southeast and Midwest), the boundaries of Brazilian electricity system are clearly defined.

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

Since the Brazilian DNA has made available the emission factor calculation based on information of the grid power plants only, the off-grid power plants are not considered (Option I).

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

[10] "*If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used*"

The method adopted to calculate the operating margin is “Dispatch data analysis OM” (Option c). The calculation is performed by the Brazilian DNA and made publicly available.

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

The selected method is the "*Dispatch data analysis OM*".

The Dispatch Data emission factor (OM), is calculated as follows:

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

Where:

$EF_{grid,OM-DD,y}$ = Dispatch data analysis operating margin CO_2 emission factor in year y (tCO_2/MWh);

$EG_{PJ,h}$ = Electricity displaced by the project activity in hour h of year y (MWh);

$EF_{EL,DD,h}$ = CO_2 emission factor for 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

$EF_{EL,DD,h}$ approach is defined by the Brazilian DNA who is the responsible for the calculation.

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

For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE.

According to the tool, the build margin emission factor (BM) is calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_{m} EG_{m,y}.EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

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)

$EF_{EL,m,y}$ = 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 electricity generation data is available

The CO_2 emission factor of each power unit *m* ($EF_{EL,m,y}$) should be determined as per the tool in Step 4 (a) for the simple OM, using options A1, A2 or A3, using for *y* the most recent historical year for which electricity generation data is available, and using for *m* the power units included in the build margin.

The power units included in the build margin are defined by the Brazilian DNA who is responsible for the operating margin and build margin calculations. The results of these are made publicly available in its web site for consultation. For the second crediting period, the build margin emissions factor shall be calculated ex ante.

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

For calculation of combined margin emission factor the weighted average CM method (Option a) should be used as the preferred option.

$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$

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 (per cent)

w_{BM} = Weighting of build margin emissions factor (per cent)

Considering that the project activity is SHP based, the calculation of the combined margin emissions factor shall use the following default values for w_{OM} and w_{BM}:

w_{OM} = 0.50 and w_{BM} = 0.50 for the first crediting period.

Table below provides an overview of the data collected to monitor and to calculate Baseline Emissions of Foz do Chapecó Project for this monitoring period.

Table 2 – Baseline emissions

Years	EFgrid,OM* (tCO_2/MWh)	EFgrid,BM* (tCO_2/MWh)	W_{OM}	W_{BM}	EFgrid,CM* (tCO_2/MWh)	Net Electricity - EGy (MWh/yr)	BEy (Baseline Emissions) (tCO_2e/yr)

2012	0.5779	0.2010	0.5	0.5	0.3895	1,491,444.15	580,867
2013	0.5932	0.2713	0.5	0.5	0.4322	4,130,870.35	1,785,551
2014	0.5837	0.2963	0.5	0.5	0.4400	5,086,805.77	2,238,088
2015	0.5597	0.2553	0.5	0.5	0.4075	5,387,312.07	2,195,217
2016	0.6228	0.1581	0.5	0.5	0.3904	4,682,993.00	1,828,435
2017	0.5882	0.0028	0.5	0.5	0.2955	3,376,820.00	997,779
2018	0.5390	0.1370	0.5	0.5	0.3380	3,520,188.48	1,189,897
2019	0.5181	0.1020	0.5	0.5	0.3100	3,709,080.36	1,149,984
2020	0.4296	0.0979	0.5	0.5	0.2638	1,838,898.23	485,018
TOTAL						**33,224,412.40**	**12,450,836**

5.2 Project Emissions

According to ACM0002 (version 13.0.0) methodology, the project emissions and the power density are calculated below.

For most renewable power generation project activities, PEy = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y} \quad \textbf{Equation 2}$$

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 ofnon-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)

For hydro power project activities that result in new single or multiple reservoirs and hydro power project activities that result in the increase of single or multiple existing reservoirs, project proponents shall account for CH4 and CO2 emissions from the reservoirs, estimated as follows:

(a) If the power density of the single or multiple reservoirs is greater than 4 W/m^2 and less than or equal to 10 W/m^2.

$$PE_{HP,y} = EF_{Res} * TEG_y \quad \textbf{Equation 3}$$

1000

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($kgCO_2e/MWh$)

TE_{Gy} = Total electricity produced by the project activity, including the electricity supplied to thegrid and the electricity supplied to internal loads, in year y (MWh)

(b) If the power density of the project activity is greater

than 10 W/m^2

$PE_{HP,y} = 0$

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \qquad \textbf{Equation 4}$$

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 projectactivity (W)

Cap_{BL} = Installed capacity of the hydro power plant before the implementation of the projectactivity (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 theimplementation 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 theimplementation of the project activity, when the reservoir is full (m^2).

For new reservoirs, this value is zero.

The power density of Foz do Chapecó Power Plant is 10.68 W/m^2. Therefore emissions from its reservoir must not be considered.

Project emission reduction is calculated according version 13.0.0 of ACM0002 methodology. As mentioned previously, LEy and PEy are zero. Emission reduction is calculated as described below:

$$ER_y = BE_y - PE_y \quad \text{Equation 5}$$

Where:

ER_y = Emission Reduction in year y (tCO2e/yr)

BE_y = Baseline emissions in year y (tCO2e/yr)

PE_y = Project emissions in year y (tCO2e/yr)

The emission reductions due to the project activity during the monitored period are summarized below:

Table 3 – Emissions Reductions

Year	Emission Reduction (tCO_2e/yr)
2012 (July until December)	580,867
2013 (January until December)	1,785,551
2014 (January until December)	2,238,088
2015 (January until December)	2,195,217
2016 (January until December)	1,828,435
2017 (January until December)	997,779
2018 (January until December)	1,189,897
2019 (January until December)	1,149,984
2020 (January until October)	485,018
Total	**12,450,836**

5.3 Leakage

There is no leakage for the project activity according to methodology ACM0002 (Version 13.0.0).

5.4 Net GHG Emission Reductions and Removals

Since:

$$ER_y = BE_y - PE_{HP,y}$$

Where:

ER = Emission reductions in year y (tCO_{2e}/yr)

BE = Baseline emissions in year y (tCO_2/yr)

PE = Project emissions in year y (tCO_{2e}/yr)

Considerening the emissions related to the SHP reservoirs are zero ($PE_{HP,y}$ = 0), the Project activity emissions reductions are calculated as below:

$$ER_y = BE_y \ (tCO_2/yr)$$

The baseline emission (BE_y) are better described on Section 5.1 with the steps descriptions and parameters used.

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2012	580,867	0	0	580,867
2013	1,785,551	0	0	1,785,551
2014	2,238,088	0	0	2,238,088
2015	2,195,217	0	0	2,195,217
2016	1,828,435	0	0	1,828,435
2017	997,779	0	0	997,779
2018	1,189,897	0	0	1,189,897
2019	1,149,984	0	0	1,149,984

2020	485,018	*0*	*0*	485,018
Total	***12,450,836***	***0***	***0***	***12,450,836***

Comparison between *ex-ante* and *ex-post* monitored period:

The *ex-ante* emission reduction estimation for the monitored period results in forecasted 6,206,005 VCUs.

The calculation is based on 31,220,640 MWh (total electricity supplied to the grid) and emission factor of 0.1988 tCO_2/MWh.

In the *ex-post* monitored period the total electricity achieved was 33,224,412 (6.42% only over) but the average emission factor for the monitored period has achieved 0.3630 tCO_2/MWh (82.60% over) resulting in a total of 12,450,836 VCUs (100.63% over).

Based on the numbers above is it possible to conclude that the emission factor was very higher during the *ex-post* period (due to major use of fossil fuelled Power plants in Brazil).