CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Ibirama Small Hydropower Plant – a Brennand CDM Project Activity.

PDD version number: 07.

Date: 19/09/2011.

A.2. Description of the project activity:

The primary objective of Ibirama Small Hydropower Plant Project Activity (Ibirama SHPP Project) is to help meet Brazil's rising demand for energy due to economic growth and to improve the supply of electricity, while contributing to environmental, social and economic sustainability by increasing the share of renewable energy in total electricity consumption for Brazil (and for the region of Latin America and the Caribbean).

Countries in the Latin America and the Caribbean region have expressed their commitment towards achieving a target of 10% renewable energy of total energy use in the region. Through an initiative from the Ministers of the Environment in 2002[1], a preliminary meeting of the World Summit for Sustainable Development (WSSD) was held in Johannesburg in 2002. In the WSSD final Plan of Implementation no specific targets or timeframes were stated, however, their importance was recognized for achieving sustainability in accordance with the Millennium Development Goals[2].

The privatization process initiated in 1995 commenced with the expectation of adequate tariffs (fewer subsidies) and better prices for generators. It drew the attention of investors to possible alternatives not available in the centrally planned electricity market. Unfortunately, the Brazilian energy market lacked a consistent expansion plan; the current expansion plan contains major problems such as political and regulatory uncertainties. In the late 1990's a strong increase in demand contrasted with a less-than-average increase in installed capacity caused the outbreak of the supply crisis/rationing in 2001/2002. One of the solutions the government provided was flexible legislation, which favored smaller independent energy producers. Furthermore the possible eligibility under the Clean Development Mechanism of the Kyoto Protocol drew the attention of investors to small hydropower projects.

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[1] UNEP-LAC (2002). Final Report of the 7th Meeting of the Inter-Sessional Committee of the Forum of Ministers of Environment of Latin America and the Caribbean. United Nations Environment Programme, Regional Office for Latin America and the Caribbean. 15 to 17 May, 2002, São Paulo (Brazil).

[2] WSSD Plan of Implementation, Paragraph 19 (e): "*Diversify energy supply by developing advanced, cleaner, more efficient, affordable and cost-effective energy technologies, including fossil fuel technologies and renewable energy technologies, hydro included, and their transfer to developing countries on concessional terms as mutually agreed. With a sense of urgency, substantially increase the global share of renewable energy sources with the objective of increasing its contribution to total energy supply, recognizing the role of national and voluntary regional targets as well as initiatives, where they exist, and ensuring that energy policies are supportive to developing countries' efforts to eradicate poverty, and regularly evaluate available data to review progress to this end.*"

This cleaner source of electricity also provides an important contribution to environmental sustainability by reducing carbon dioxide emissions that otherwise would have occurred in the absence of the project. The project activity reduces emissions of greenhouse gas (GHG) by avoiding electricity generation from fossil fuel sources (and CO_2 emissions), which would be generated (and emitted) in the absence of the project.

The project consists of the construction of a small hydropower plant ("PCH", from the Portuguese *Pequena Central Hidrelétrica*) with 21 MW of installed capacity[3] and a reservoir area of 0.13 km^2[4]. The plant is located in the Ibirama municipality, State of Santa Catarina, Brazil's Southern region. Ibirama started operation in December 2010[5].

Ibirama Energética S.A., the company that controls Ibirama Small Hydropower Plant, is owned by Empreendimentos Energéticos e Participações Ltda. and MM Energia Ltda. Empreendimentos Energéticos e Participações Ltda. is the major shareholder of Ibirama Energética S.A. and is owned by the Brennand Group.

The Brennand Group started its activities related to energy generation projects with the construction of three small hydropower plants: Antônio Brennand, Indiavaí and Ombreiras, which are already registered under CDM Project Activity (ARAPUtanga Centrais Elétricas S. A. - ARAPUCEL - Small Hydroelectric Power Plants Project, CDM 0530[6]).

Prior to the implementation of the project activity no small hydropower plant was operational in the location where the Ibirama project is being built. The project activity will reduce emissions of GHG by avoiding electricity generation from fossil fuel sources, which would be generated (and emitted) in the absence of the project. In conclusion, the baseline scenario and the scenario without the project activity are the same.

Ibirama SHPP Project can be seen as a solution by the private sector to the Brazilian electricity crisis of 2001, contributing to sustainable development and having a positive effect for the country beyond the evident reductions in GHG.

Although Ibirama does not have a relevant positive impact in the host country given its electric system size, it is without reasonable doubt part of a greater idea. The project contributes to sustainable development since it meets the present needs without compromising the ability of future generations to meet their own needs, as defined by the Brundtland Commission (1987). In other words, the implementation of small hydroelectric power plants ensures renewable energy generation, reduces the national electric system demand, avoids negative social and environmental impact caused by the

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[3] Sum of the nominal power of the three generators used in the project as requested by DOE. Detailed information is presented in CL 14 of the Validation Protocol. Project licenses and the authorizations issued by the Brazilian Power Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica – ANEEL*) also indicate 21 MW of installed capacity for Ibirama project.

[4] See the Construction License # 0013 of the project issued on February 18th, 2009.

[5] ANEEL Resolution # 3,961 issued on December 20th, 2010. Available at: <http://www.aneel.gov.br/cedoc/dsp20103961.pdf>.

[6] Source: United Nations Framework Convention on Climate Change (UNFCCC) website. Available at: <http://cdm.unfccc.int/Projects/DB/TUEV-SUED1152891235.76/view>.

construction of large hydropower plants with large reservoirs and fossil fuel thermo power plants, and drives regional economies, increasing quality of life in local communities.

Therefore, indisputably the project has reduced negative environmental impacts and has developed the regional economy, resulting, consequently, in better quality of life. In other words, environmental sustainability combined with social and economic justice, undeniably contribute to the host country's sustainable development.

A.3. Project participants:

Table 1 - Party(ies) and private/public entities involved in the project activity

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved whishes to be considered as project participant (Yes/No)
Brazil (host)	Ibirama Energética S.A. (Private entity)	No
	Ecopart Assessoria em Negócios Empresariais Ltda. (Private entity)	
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Detailed contact information on party(ies) and private/public entities involved in the project activity is listed in Annex 1.

A.4. Technical description of the project activity:

By legal definition established by the Brazilian Power Regulatory Agency – ANEEL – through the Resolution # 652/2003[7], a small hydro consists of a utility with an installed capacity between 1 MW and 30 MW, and have a reservoir area smaller than 3 km².

Ibirama Small Hydropower Plant Project Activity is under construction in Itajaí do Norte River, Itajaí-Açu River Basin, located in the municipality of Ibirama, State of Santa Catarina. It has an installed capacity of 21 MW and a reservoir area 0.13 km^2 (power density of 161.6 W/m^2), which stores water in order to generate electricity for short periods of time. Hence, it complies with ANEEL's definition. Furthermore, it is also classified as a new hydro electric project with a new reservoir and a power density greater than 4

[7] ANEEL – *Agência Nacional de Energia Elétrica*. Resolution # 652, dated Decembro 9th, 2003. Available at: <http://www.aneel.gov.br/cedoc/res2003652.pdf>.

W/m^2, according to ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources".

Additionally, the plant is considered a run-of-river project which does not include significant water storage, and must make complete use of the water flow. A typical run-of-river scheme involves a low-level diversion dam and is usually located on swift flows (Figure 1).

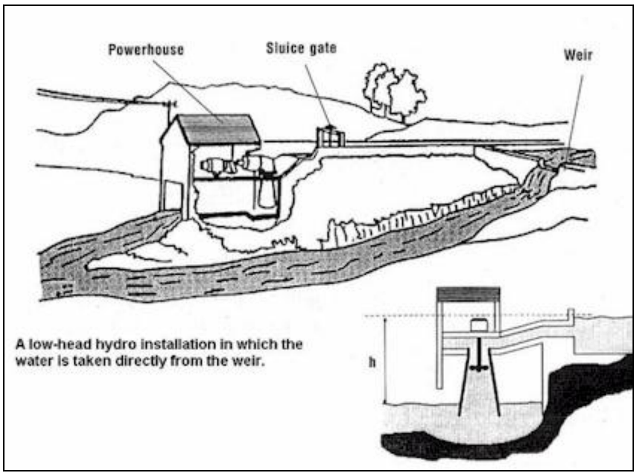

Figure 1 - Schematic view of run-of-river power plant

Acciording to the definition of the World Commission of Dams (WCD)[8]: *"Run-of-river dams are dams that create a hydraulic head in the river to divert some portion of the river flows. They have no storage reservoir or limited daily pondage. Within these general classifications there is considerable diversity in scale, design, operation and potential for adverse impacts."*

Table 2 – Water daily pondage

Volume of reservoir (m^3)[9]	1,250,000
Dry season average flow rate (m^3/s)[10]	48.8
Days of pondage at maximum volume of reservoir	0.30

Considering data above, water in Ibirama's reservoir has limited daily pondage; it remains in the reservoir less than 1 day. Therefore, to the understanding of the Project Participants (PPs), PCH Ibirama can be considered a run-of-river power plant according to the presented criteria.

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[8] WCD (2000). Dams and development: a new framework for decision making. World Commission on Dams. Earthscan Publications. London, U.K.

[9] Information available in the Project Design prepared by Engevix Engenharia Ltda and Mazzarollo, volume I, dated November 2001.

[10] EPE technical data report, page 2, dated February 5th, 2007.

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Brazil.

A.4.1.2. Region/State/Province etc.:

State of Santa Catarina.

A.4.1.3. City/Town/Community etc:

Ibirama.

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

Ibirama Small Hydropower Plant Project Activity is located in the Ibirama municipality, Santa Catarina State, Brazil's Southern region (Figure 2) and explores the hydrological potential of the Itajaí do Norte River. The Project's geographical coordinates are 27° 02' 15.9" South and 49° 34' 9.8" West[11].

[11] See the Construction License of the project issued on February 18th, 2009.

Figure 2 - Political division of Brazil showing the State of Santa Catarina and the city of Ibirama

Source: GOOGLE EARTH (2009)[12]

The city of Ibirama has 16,716 inhabitants and an area of 247 km^2[13].

A.4.2. Category(ies) of project activity:

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

Category: Renewable electricity generation for a grid.

A.4.3. Technology to be employed by the project activity:

The Francis turbines, used in Ibirama Small Hydropower Plants Project Activity, are the most widely used among water turbines (Figure 2).

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[12] Available at: <http://earth.google.com/>.

[13] IBGE (2007). Database - Cities. Brazilian Estatistic and Geographic Institute (in a free translation from the Portuguese *Instituto Brasileiro de Geografia e Estatística - IBGE*). Available at <http://www.ibge.gov.br/cidadesat/default.php>.

The Francis turbine is a type of hydraulic reaction turbine in which the flow exits the turbine blades in the radial direction. They are common in power generation and are used in applications where high flow rates are available at medium hydraulic head. Water enters the turbine through a spiral tank and is directed onto the blades. The low momentum water then exits the turbine through a ducting known as suction tube. In the model, water flow is supplied by a variable speed centrifugal pump. A load is applied to the turbine by means of a magnetic brake, and torque is measured by observing the deflection of calibrated springs. The performance is calculated by comparing the output energy to the energy supplied.

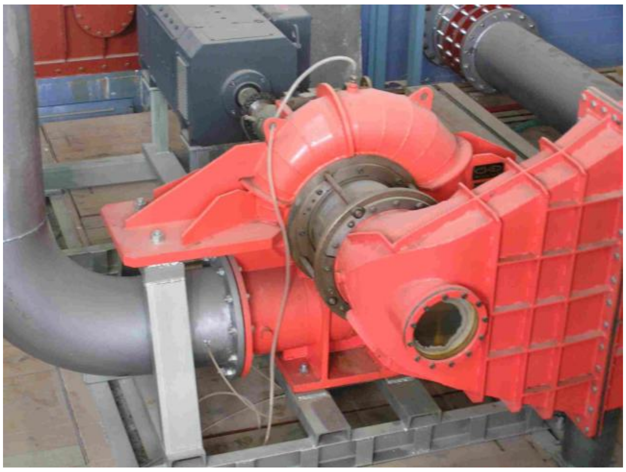

Figure 3 - Example of a Francis Turbine

Source: NTUA (2009)[14]

As mentioned earlier on section A.2., in the absence of the project activity all the energy would be supplied by other plants of the interconnected grid. Hence, the baseline scenario is identified as the continuation of the current (previous) situation of electricity. Prior to the implementation of the project activity there was no hydro operational in the same location of the project activity. Hence, the baseline scenario and the scenario without the project activity are the same.

The equipment and technology used in Ibirama Small Hydropower Plants CDM Project Activity has been successfully applied to similar projects in Brazil and around the world. Technical description of the facility follows:

Table 3 - Technical configuration of Ibirama SHPP

Description		**Ibirama SHPP**
Turbines[15]	Type	Francis
	Quantity	3

[14] NTUA (2009). Department of mechanical engineering. Fluids section. National Technical University of Athens. Available at: <http://www.fluid.mech.ntua.gr/lht/PB0303011.JPG>. Accessed on April 30th, 2009.

[15] Information available in the design data sheet issued by the turbines manufacturer dated October 1st, 2007.

	Nominal power (MW)	7.250[16]
	Speed (rpm)	400
	Grid frequency (Hz)	60
	Manufacturer	Voith Siemens
Generators[17]	Type	Syncronos
	Quantity	3
	Nominal power (kVA)	7,780
	Frequency (rpm)	400
	Power factor	0.9
	Nominal tension (V)	6,900
	Manufacturer	Gevisa S/A

It is important to mention that the main equipment used in Ibirama project was produced in Brazil. This contributes to the energy sector development resulting in more research and increasing capacity of the industrial sector.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

Emissions reductions estimations were calculated considering the arithmetic average of the monthly dispatch analysis emission factor released by the Brazilian DNA[18] for the years 2006, 2007 and 2008 (0.2326 tonCO_2e/MWh), applicable to grid-connected renewable power generation project activities in Brazil.. Full implementation of the project will generate the estimated annual reductions as presented in the table below.

Table 4 – Estimated emission reductions of the project

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year 1 - (2012)*	14,065
Year 2 - (2013)	28,363

[16] The sum of the nominal power of the three turbines was considered as the project installed capacity. Detailed information is presented in CL 14 of Validation Protocol.

[17] Information available in the technical data record issued by the generators manufacturer Gevisa S/A in July 2009.

[18] URL: http://www.mct.gov.br/index.php/content/view/73318.html (accessed on 04/02/2009).

Year 3 - (2014)	28,363
Year 4 - (2015)	28,363
Year 5 - (2016)	28,363
Year 6 - (2017)	28,363
Year 7 - (2018)	28,363
Year 8 - (2019)**	14,298
Total estimated reductions (tonnes of CO_2e)	198,541
Total number of crediting years	7
Annual average over the first crediting period of estimated reductions (tonnes of CO_2e)	28,363

*Starting on July 1st
**Until June 30th

A.4.5. Public funding of the project activity:

There is no recourse to any public funding by the PPs in the proposed project activity. The project proponents hereby confirm that there is no divergence of Official Development Assistance (ODA) to the proposed project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 12.1.0)[19].

ACM0002 refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system (Version 2.2.0);
- Tool for the demonstration and assessment of additionality (Version 5.2);
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 2).
- Combined tool to identify the baseline scenario and demonstrate additionality (version 3.0.0).

The *tool to calculate project or leakage CO_2 emission from fossil fuel combustion* and *combined tool to identify the baseline scenario and demonstrate additionality* are not applicable to the project activity, and

[19] Available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

therefore are not used.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

The methodology ACM0002 is applicable to "*grid-connected renewable power generation project activities that (a) install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (greenfield plant); (b) involve a capacity addition; (c) involve a retrofit of (an) existing plant(s); or (d) involve a replacement of (an) existing plant(s)*".

Ibirama project applies option (a) above.

The methodology also provides the following conditions:

- ✓ *The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;*

  Ibirama project corresponds to the installation of a hydropower plant with a run-of-river reservoir.

- ✓ *In the case of capacity additions, retrofits or replacements (except for wind, solar, wave or tidal power capacity addition projects which use Option 2: on page 10 to calculate the parameter* $EG_{PJ,y}$*): the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity expansion or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity;*

  Not applicable to Ibirama project.

- ✓ *In case of hydro power plants, one of the following conditions must apply:*
  - *The project activity is implemented in an existing reservoir, with no change in the volume of reservoir; or*
  - *The project activity is implemented in an existing reservoir, where the volume of reservoir is increased and the power density of the project activity, as per definitions given in the Project Emissions section, is greater than 4 W/m*^{2}*; or*
  - *The project activity results in new reservoirs and the power density of the power plant, as per definitions given in the Project Emissions section, is greater than 4 W/m*^{2}*.*

Ibirama project resulted in new reservoir and 161.6 W/m^2 power density, *i.e.* greater than 4 W/m^2. Detailed information of power density calculation is presented in section B.6.3.

Finally, the methodology has the following restrictions – *i.e.* project activities may not be applicable in the following cases:

- *Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;*

  There is not switching from fossil fuels to renewable energy source at the site of the project activity.

- *Biomass fired power plants;*

  Ibirama project is a small hydropower plant.

- *Hydro power plants that result in new reservoirs or in the increase in existing reservoirs where the power density of the power plant is less than 4 W/m^2.*

  The power density of Ibirama project is greater than 4 W/m^2.

B.3. Description of the sources and gases included in the project boundary

As described in ACM0002 methodology, the spatial extent of the project boundary includes the project power plant and all power plants connected physically to the electricity system which the CDM project power plant is connected to.

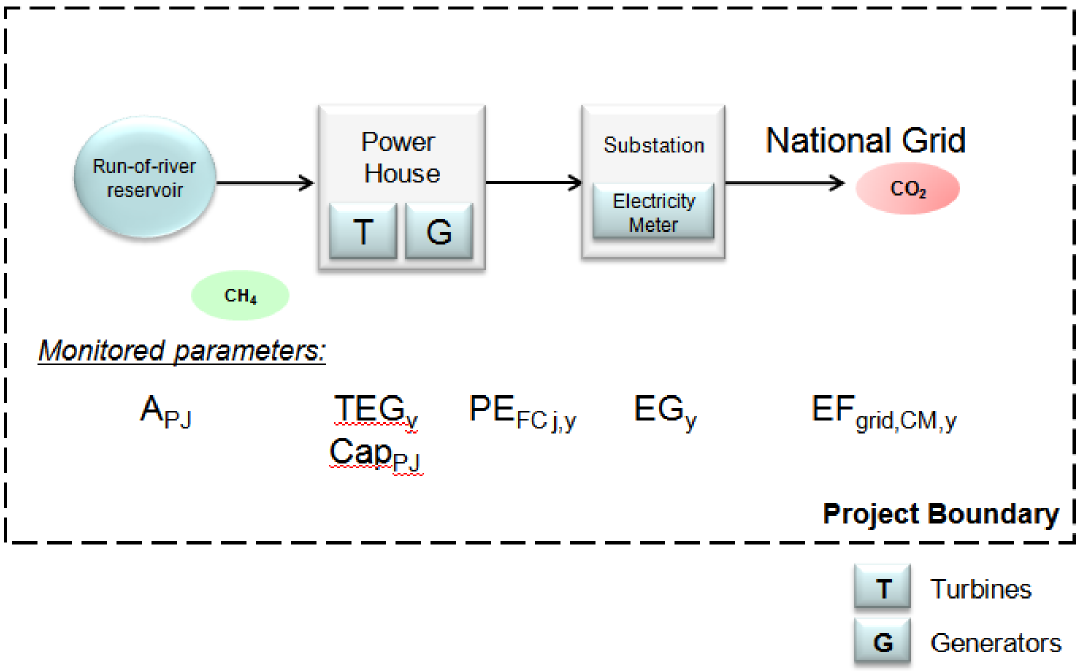

Figure 4 - Project Boundary of the project activity

The greenhouse gases and emission sources included in or excluded from the project boundary are shown in the below table.

Table 4 – Greenhouse gases and emission sources included or excluded in the project boundary

	Source	Gas	Included ?	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity.	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small
Project Activity	Emissions of CH_4 from the reservoir.	CO_2	No	Excluded for simplification. This emission source is assumed to be very small
		CH_4	No	There are no emissions from the project reservoir considering its power density of 161.6 W/m^2, *i.e.*, greater than 10 W/m^2
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The project activity does not modify or retrofit any existing electricity generation facility. Hence, accordingly to ACM0002 the baseline scenario is the following:

> *"Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations as described in the "Tool to calculate the emission factor for an electricity system".*

In the absence of the project activity, all the energy would be supplied by other plants from the interconnected grid. The project activity reduces emissions of GHG by avoiding electricity generation by fossil fuel sources (and CO_2 emissions), which would be generated (and emitted) in the absence of the project. According to ANEEL[20], 71.2 % of the Brazil's installed capacity is composed by hydro and 24.2 % by thermal power stations.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

(i) Definition of the project start date

The CDM glossary of terms defines the starting date of a non A/R project activity as "*the earliest date at which either the implementation or construction or real action of a project activity begins*". Considering this definition, the 41st CDM EB Meeting Report[21] clarified that: "*the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project*".

From the above definition, the Project Participants analyzed the timeline of the project activity:

Table 5 – Timeline of the project activity

Dates	Actions
20/03/2007	Transfer of Ibirama Energética S/A (PCH Ibirama owner) from Guascor Geratec Ltda. to Empreendimentos Energéticos e Participações Ltda.[22]
18/06/2007	Participation and selection in the 1st energy auction for renewable energy projects[23]
31/08/2007	First order of the main equipment (turbines and generators). Contract signed between Ibirama Energética S/A and Voith Siemens Hydro Power Generation Ltda.
06/12/2007	PPA signature[24]

[20] ANEEL (2008). Energy generation database (from the Portuguese *Banco de Informações de Geração – BIG*). Brazil's generation capacity. Brazilian Power Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica*). Available at: <http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp>.

[21] The 41st CDM EB Meeting Report was held on July 30th to August 2nd, 2008. See Meeting Report available at the UNFCCC's website: <http://cdm.unfccc.int/>.

[22] ANEEL Resolution # 852, dated March 20th, 2007. Public information available at ANEEL's website: <http://www.aneel.gov.br/>. #

[23] Public information available at CCEE's website: <http://www.ccee.org.br/>.

18/02/2009	Issuance of the Construction Permit (installation license)[25]
01/06/2009	EPC contract signature between Ibirama Energética S/A and Bucagrans – Construtora de Obras Ltda.
01/07/2009	Construction starting[26]
19/10/2009	Financing contract signature[27]
01/12/2010	Commission starting[28]
17/12/2010	Issuance of the Operation License[29]
21/12/2010	Operation starting[30]
04/01/2011	Signature of the financing contract amendment[31]

Guascor Geratec Ltda. and Empreendimentos Energéticos e Participações Ltda. are different companies. Guascor Geratec Ltda. was the first owner of Ibirama project and Empreendimentos Energéticos Ltda. is the current owner from Brennand Energia Group.

As can be seen, the transfer of the Ibirama project from Guascor Geratec Ltda. to Empreendimentos Energéticos e Participações Ltda. and the participation in the 1st energy auction for renewable energy projects occurred first. However, considering the definition from the CDM EB in the 41st meeting, the first order of the main equipment shall be considered as the project start date, *i.e*, August 31st, 2007, since the project sponsor committed expenditures for the project construction and itself to terms of the contract.

In addition, Brennand Group could undoubtedly have sold Ibirama project if legal/regulatory aspects were not favourable for the project implementation and CDM revenues were considered unfeasible at that time. In reality, this is not uncommon and a project is purchased more than once.

All documents related to the dates presented in the timeline above are available with the PPs and were presented to DOE during validation.

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[24] Signature of the PPAs (from the Portuguese *Contrato de Comercialização de Energia Elétrica no Ambiente Regulado – CCEAR*).

[25] Construction License # 0013/09 issued on February 18th, 2009 by the Environmental Agency of Santa Catarina (Fundação do Meio Ambiente – FATMA).

[26] Public information available in the ANEEL's report *Acompanhamento das Pequenas Centrais Hidrelétricas com Licença de Instalação*, dated December 15th, 2009. ANEEL's website: <http://www.aneel.gov.br/>.

[27] Financing contract signed between Ibirama Energética S/A and Itaú Bank on October 19th, 2009.

[28] ANEEL Ordinance # 3,643 issued on November 30th, 2010. Available at ANEEL's website: <http://www.aneel.gov.br/cedoc/dsp20103643.pdf>.

[29] Construction License # 086/2010 issued by the environmental agency of Santa Catarina state on December 17th, 2010.

[30] ANEEL Ordinance # 3,961 issued on December 20th, 2010. Available at ANEEL's website: <http://www.aneel.gov.br/cedoc/dsp20103961.pdf>.

[31] Financing contract amendment signed between Ibirama Energética S/A and Itaú Bank on January 4th, 2011.

(ii) Demonstration of the prior consideration of the CDM

The consideration of the CDM incentive is dated April 10th, 2006. This can be demonstrated through the Minutes of Meeting held by Empreendimentos Energéticos e Participações Ltda., the major shareholder of Ibirama Energética S.A.

Empreendimentos Energéticos e Participações Ltda. is a Brennand Group Company. On March 20th, 2007, Empreendimentos Energéticos e Participações Ltda. was incorporated by Ibirama Energética S.A., the concurrent owner of the PCH. This can be demonstrated through ANEEL Resolution # 852/2007[32].

In the meeting mentioned above, the president of Empreendimentos Energéticos e Participações Ltda. Mr. Mozart de Siqueira Campos Araújo and his secretary Mr. Pedro Pontual Marletti were present. From this meeting, the Board members decided to undertake the project acquisition, considering the fact that the project could be registered under CDM and generate carbon credits. The CDM revenues were considered essential to overcome risks related to the high volatility of energy price in Brazil.

Two conditions were important for the Board's approval of the Ibirama project: legal and regulatory aspects and the possibility of generating CERs, which would make the project feasible. With the successful development of ARAPUtanga Centrais Elétricas S. A. - ARAPUCEL - Small Hydroelectric Power Plants Project[33] (three small hydropower plants – Antônio Brennand, Indiavaí and Ombreiras – registered under CDM), owned by the same PPs, the CDM process was better known and the decision to implement another project considering the CDM revenues was reinforced.

All documents related to the information presented above are available with the PPs and were presented to DOE.

As mentioned above, it is important to highlight that Brennand Group has three small hydropower plants - Antônio Brennand, Indiavaí and Ombreiras - which are also registered CDM Project Activity (ARAPUtanga Centrais Elétricas S. A. - ARAPUCEL - Small Hydroelectric Power Plants Project, CDM 0530[34]). This is further evidence of Brennand Group's confidence in the CDM and in the certified emission reductions potential to help projects overcoming implementation barriers. Additionally, Ibirama Energética S/A had already contracted Ecopart Assessoria Ltda. to advise them as to the CDM process for PCH Ibirama project on July 6th, 2005. At that time, Ibirama Energética S.A was controlled by Guascor Geratec Ltda. For a better understanding, a timeline of actions taken by the PPs demonstrating prior consideration of CDM for the Ibirama project is as follows:

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[32] ANEEL – *Agência Nacional de Energia Elétrica*. Resolução # 852 issued on March 20th, 2007.

[33] Ref.: CDM 0530. Available at UNFCCC's website: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1152891235.76/view

[34] Source: United Nations Framework Convention on Climate Change (UNFCCC) website. Available at: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1152891235.76/view.

Table 6 – CDM consideration

Dates	Actions
06/07/2005	Constract signature between Ibirama Energética S/A and Ecopart Assessoria em Negócios Empresariais Ltda.
10/04/2006	Empreendimentos Energéticos e Participações Ltda. minutes of meeting
06/02/2007	Ecopart asked preliminary information for issuance of CDM services proposal
21/11/2007	Ecopart sent complete questionnaire to be responded by Brennand Group for PDD elaboration
23/01/2008	Brennand Group sent responses for the questionnaire
14/02/2008	Ecopart requested validation proposals for DOEs
28/05/2008	Signature of the contract between Ecopart and Ibirama Energética S/A
17/06/2008	Ecopart sent letters for stakeholders' comments
18/03/2009	Ecopart requested validation proposals for DOEs (for the second time)
24/04/2009	Ecopart sent letters for stakeholders' comments (for the second time)
17/09/2009 – 16/10/2009	Global Stakeholder Process (GSP)

Although Ibirama Energética S/A signed a contract with Ecopart Assessoria Ltda. for developing the CDM process of the small hydropower plant project on July 6th, 2005, for a conservative analysis, the date on which Empreendimentos Energéticos e Participações Ltda. held a meeting, deciding to buy Ibirama Energética S/A from Guascor Geratec Ltda. (on April 10th, 2006) considering carbon credits revenues, was considered for CDM considerations purpose.

(iii) Fulfillment of the requirements presented in the "Tool for the demonstration and assessment of additionality"

For the demonstration of additionality, the proposed baseline methodology refers to the Additionality Tool (here version 5.2, the most recent one at the time PDD is being developed) approved by the Executive Board. The tool considers some important steps necessary to determine whether the project activity is additional and to demonstrate how the emission reductions would not occur in the absence of PCH Ibirama Project. The application of the above mentioned tool is described in the next paragraphs.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulation

Sub-step 1a. Define alternatives to the project activity:

Scenario 1: The alternative to the project activity is the continuation of the current (previous) situation of electricity supplied by the existing power plants from the interconnected system.

Scenario 2: The proposed project activity undertaken without being registered as a CDM project activity.

Sub-step 1b. Consistency with mandatory laws and regulations:

Both alternatives, the project activity and the alternative scenario, are in compliance with all regulations according the following entities:

- The National Electric System Operator (ONS from the Portuguese *Operador Nacional do Sistema Elétrico*);
- The Electricity Regulatory Agency (ANEEL from the Portuguese *Agência Nacional de Energia Elétrica*);
- The Mines and Energy Ministry (in a free translation from the Portuguese *Ministério de Minas e Energia – MME*);
- The Chamber of Electrical Energy Commercialization (in a free translation from the Portuguese *Câmara de Comercialização de Energia Elétrica – CCEE*);
- The Santa Catarina Environmental Agency (from the Portuguese *FATMA - Fundação do Meio Ambiente*);
- The CDM Executive Board.

SATISFIED/PASS – Proceed to Step 2

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Once the project activity generates other financial benefit other than CDM related income (sale of energy) Option I could not be chosen. Option III is more appropriate when compared to Option II because there are no other options of investment from the project owner perspective. Therefore, additionality is demonstrated here through an investment benchmark analysis (option III).

Sub-step 2b. Option III – Apply benchmark analysis

Financial indicator identified for PCH Ibirama Project Activity is the project Internal Rate of Return (IRR). The IRR here presented is compared to the appropriate benchmark of the electric sector, which is the Cost of Equity (Ke) calculated based on the Capital Asset Pricing Model (CAPM).

Benchmark - Cost of Equity (Ke)

According to the "Tool for the demonstration and assessment of additionality," paragraph (6), discount rates and benchmarks shall be derived from, among other options "*(a) Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert or documented by official publicly available financial data*". As explained below, the Capital Asset Pricing Model (CAPM) calculation is in accordance to the mentioned tool.

The CAPM is one of the most widely accepted models used to determine the required rate of return on equity. The CAPM calculates a newly introduced asset's non-diversifiable risk. CAPM takes into account the asset's sensitivity to non-diversifiable risk, better referred to as beta (**β**). Embedded in the model is also the market premium which can be tracked using historical data from the local or relevant equity market.

The rate which is charged for the equity component of a project is calculated through the formula: **Ke = Rf + β x Rm + Rc** where **Ke** represents the rate of return for equity investments.

Rf stands for the risk free rate. The risk-free rate used for **Ke** calculation was a long term bond rate. This bond was issued by the Brazilian government, denominated in US dollars. Therefore the rate includes the Brazilian country risk. There is a higher risk associated to investing in Brazil, or in Brazilian bonds, compared to investing in a mature market such as the United States. This risk is reflected in higher returns expected on Brazilian government bonds compared to the mature markets government bonds. In considering the Brazilian government bond, this premium for a higher risk is captured in our calculations.

In order to adjust the risk-free rate to the inflation adjusted rate, the expected inflation rate (for the United States) is reduced. The inflation is calculated based on the treasury through spot TIPS (Treasury Inflation Protected Securities) which are readily quoted in the market. There is no need to adjust for Brazil's expected inflation when dealing with a hurdle rate in real terms.

Beta, or **β,** stands for the average sensitivity of comparable companies in that industry to movements in the underlying market. **β** derives from the correlation between returns of US companies from the sector and the performance of the returns of the US market. **β** has been adjusted to the leverage of Brazilian companies in the sector, reflecting both structural and financial risks. **β** adjusts the market premium to the sector.

Rm represents the market premium, or higher return, expected by market participants in light of historical spreads attained from investing in equities versus risk free assets such as government bond rates, investors require a higher return when investing in private companies.The market premium is estimated based on the historical difference between the S&P 500 returns and the long term US bonds returns. The spread over the risk-free rate is the average of the difference between those returns.

Note that in the formula above there is the factor EMBI+ (Emerging Markets Bond Index Plus), considers as the country risk premium, **Rc**. This factor accounts for the country or sovereign risk embedded in the debt of a country. Assuming that relative to the US risk-free debt market EMBI+ is 0, then Brazil's EMBI+ would calculate for the added or reduced risk relative of Brazils debt markets to the US.

Justification for the EMBI+ addition to the risk-free rate lies in the vast differences between the United States in such factors as credit risk, inflation history, politics, debt markets, and more. Ignoring these differences would result in the incorrect application of relevant environmental factors in the decision-making process of an investor in Brazil.

Table 7 – Cost of Equity (Ke) calculation

Cost of Equity	
(Rf) Risk-free rate[35]	4.29%p.a.
US expected inflation[36]	2.46% p.a.
(Rm) Equity Risk Premium[37]	6.47%p.a.
(β) Adjusted Industry Beta[38]	1.49%p.a.
(Rc) Estimated Country Risk Premium[39]	8.07%p.a.
Cost of Equity with Brazilian Country Risk	19.53%p.a.

Considering the table above, cost of equity is 19.53% p.a. Each assumption made and all data used to estimate the Ke through CAPM was presented to the DOE. The spreadsheet used for calculation of the Ke was also provided to the DOE.

Financial Indicator - Internal rate of return (IRR)

As mentioned above, the financial indicator identified for Ibirama Project Activity is the equity Internal Rate of Return (IRR). Ibirama cash flow over its lifetime of 29 years[40] shows that the equity IRR is

[35] 10-year US Treasury Yield. Information available at The Federal Reserve website: <http://www.federalreserve.gov/releases/h15/data/Business_day/H15_TCMNOM_Y10.txt>.

[36] 10-year T.Notes minus 10-year TIPS. Information available at the Federal Reserve website: < http://www.federalreserve.gov/econresdata/researchdata.htm>.

[37] Historical S&P500 premium over 10-year US-Treasury Bond. Available at Damodaran's website: <http://pages.stern.nyu.edu/~adamodar/>.

[38] Average Beta US Power Companies re-levered to Brazilian leverage. Available at Damodaran's website: <http://pages.stern.nyu.edu/~adamodar/>.

[39] Emerging Markets Bond Index Plus Brazil. Index calculated by JPMorgan. Information available at: <http://www.cbonds.info/all/eng/index/index_detail/group_id/1/>.

[40] According to ANEEL Resolution # 24, issued on 27/01/2004, Art 7, the project concession is valid for 30 years from the issuance of this Resolution. Therefore, the period of 30 years also includes the project design/study and construction, i.e., the project lifetime is from 2004 to 2034.

14.25%. Considering DOE request during validation[41], Project Participants included the CERs revenues in the project cash flow although, to the best of the Project Participants understanding, there are no guidance, guidelines and/or procedures which require this assessment. The inclusion of the CERs revenues resulted in an IRR of 15.76%.

The table presented below provides a list of the main input values as well as source of information.

Parameter	Value	Source of information used
Installed Capacity (MW)	21	▪ ANEEL Resolution # 24 issued on January 27th, 2004. Available at ANEEL's website: <http://www.aneel.gov.br/cedoc/rea2004024.pdf>. ▪ Construction licence # 0013, 18/02/2009 issued by the environmental agency of Santa Catarina state.
Plant Load Factor (PLF)	66%	The PLF is calculated based on the energy assured of the project (13.92 MW-ave): 13.92 MW-ave ÷ 21 MW = 66% The energy assured of the project can be checked at: ▪ ANEEL Resolution # 65, issued on May 25th, 2004 (121,939 MWh/year). Available at: <http://www.aneel.gov.br/cedoc/bren2004065.pdf>. ▪ ANEEL Ordinance # 1,368, issued on 27/06/2006 (13.92 MW-ave). Available at: <http://www.aneel.gov.br/cedoc/dsp20061368.pdf>. Considering 8,760 hours in a year: 13.92 MW-ave x 8,760 hours = 121,939 MWh/year Therefore, the PLF of Ibirama project applies option (a) of the “Guidelines for the reporting and validation of plant load factors” (Annex 11, EB 48).
PPA price (R$/MWh)	114.00	Câmara de Comercialização de Energia Elétrica (CCEE). Weighted average of the energy prices negotiated in the Brazilian energy auction destined to new hydropower plant projects in 2005. Information available at CCEE's websiste: <http://www.ccee.org.br/>.
Investment	74,880,348	Based on the project sponsor experience with other small

[41] See CAR 1 of the Validation Protocol.

		hydropower plant. Balance sheet of Antonio Brennand small hydropower plant published in D.O.U. (Diário Oficial da União) in July 2005 (around BRL 3,5 MM/MW). Value can be cross-checked with: The BNDES Annual Report 2005. Main approved operations - electricity generation (from the Portuguese *Principais operações aprovadas* - *segmento de geração*), page 59: BRL 3,9 MM/MW for small hydropower plants (BRL 3bi / 763 MW).

Project cash flow was submitted to the DOE and is available with the Project Participants.

Sub-step 2c. Calculation and comparison of financial indicators

Ibirama cash flow demonstrates that the IRR of the project (14.25%) is lower than the cost of equity (19.53%). This demonstrates that the project activity is not financially attractive to investor:

Project	IRR (%)	IRR with CERs revenues (%)	Cost of Equity (%)
Ibirama	14.25	15.76	19.53

Sub-step 2d. Sensitivity analysis

A sensitivity analysis was conducted by altering the following parameters:

- Increase in project revenue (energy price and plant load factor/energy assured);
- Reduction in running costs (operation costs and investments).

According to the Guidelines on the Assessment of Investment Analysis (version 3) "*variations in the sensitivity analysis should at least cover a range of +10% and -10%*". Therefore, financial analysis was performed altering each of the parameters mentioned above by 10%, and assessing what the impact on the IRR would be. The results of the sensitivity analysis are shown in the table below. As it can be seen, the equity IRR remains below the benchmark even in the case when the parameters change in favor of the project.

Table 4 – Sensitivity analysis 1

Scenario	% change	IRR (%)

Original	-	14.25
Increase in the energy price	10%	17.20
Increase in the project plant load factor (PLF)/energy assured		17.20
Reduction in project costs		15.00
Reduction in project investment		17.49

It is important to note that the average for Brazilian inflation in 2006 was equal to 3.14%[42]. The use of 10% of variation, around three times the 2006 inflation rate, in the variation of costs and revenues of the project activity was chosen as a very conservative value.

In addition, Project Participants conducted the sensitivity analysis by altering each parameter until the IRR reaches the benchmark (19.53%) as requested by DOE[43]. Results of this sensitivity analysis are presented in the table below:

Table 8 – Sensitivity analysis 2

Scenario	**% change**
(a) Increase in the energy price	18%
(b) Increase in the project plant load factor (PLF)/energy assured	18%
(c) Reduction in project costs	71%
(d) Reduction in project investments	17%

Furthermore, the probability of the occurrence of these scenarios was analyzed:

(a) Increase in the energy price

The energy price considered in the project cash flow is based on the energy auction held on December 16th, 2005 for new hydropower plant projects – BRL 114/MWh. Considering an increase in the energy price of 18% to the IRR reaches the benchmark, the energy price would be BRL 134.45/MWh. However, the results of the energy auctions (in a free translation from Portuguese *Leilão de Energia Nova*) for the electricity supply for the period from 2008 to 2012 demonstrates that the price of BRL 134.45/MWh would not be reasonable.

[42] The IPCA is used as a parameter for the inflation targeting system. In 2006 IPCA's accumulated growth was equal to 3.14%. This index is published by several institutions in the country. One of these institutions is the Central Bank of Brazil in its annual bulletins available at <http://www.bcb.gov.br/?BOLETIM2006>.

[43] See Corrective Action Request (CAR) 1 of the Validation Report.

Table 9 – Energy auction results for new projects from 2008-2012

		Hydro	Biomass	Natural gas	Coal	Oil	Total
2008	MW-ave	71	31	352	0	178	632
	MWh	622,358	271,734	3,085,491	0	1,560,277	5,539,859
	BRL/MWh	106.95	111.04	131.00	0.00	138.44	129.42
2009	MW-ave	1074	110	479	0	642	2305
	MWh	9,414,254	964,216	4,198,722	0	7,627,515	22,204,707
	BRL/MWh	124.38	133.80	127.25	0.00	134.77	128.32
2010	MW-ave	935	140	570	292	1304	3241
	MWh	8,195,836	1,227,184	4,996,392	2,559,555	11,430,342	28,409,309
	BRL/MWh	115.48	138.85	120.35	124.67	134.67	125.90
2011	MW-ave	569	61	400	0	74	1104
	MWh	4,987,626	534,702	3,506,240	0	648,654	9,677,222
	BRL/MWh	121.86	137.10	137.44	0.00	137.72	129.41
2012	MW-ave	715	0	351	930	316	2312
	MWh	6,267,404	0	3,076,726	8,152,008	2,769,930	20,266,067
	BRL/MWh	129.14	0.00	129.34	126.97	131.40	128.61
Total	MW-ave	3,364	342	2,152	1,222	2,514	9,594
	MWh	29,487,478	2,997,836	18,863,571	10,711,563	24,036,718	86,097,164
	Share	35.1%	3.6%	22.4%	12.7%	26.2%	100.0%
	BRL/MWh	119.56	104.16	129.08	50.33	135.40	128.33

Source: ESPARTA (2008)[44]

As per the average energy prices indicated above, it is very unlikely that energy prices from hydropower plants would surpass BRL 134.45/MWh – for an IRR above benchmark. The highest energy price from hydropower projects was BRL 129.14/MWh.

It is worth mentioning that energy auctions promoted by the government are an official reference for the energy prices analysis by energy players in Brazil. Official information regarding electric energy auctions are publicly available and can be obtained at the Chamber of Electric Energy Commercialization's website: <http://www.ccee.org.br/>.

Ibirama project was selected in the energy auction for alternative energy sources only (small-hydro as Ibirama project, wind and biomass). As a result, only 18 projects were selected, resulting in 185 MW-

[44] ESPARTA, A. R. J. (2008). Greenhouse gases emission reductions in the Brazilian power sector: Kyoto Protocol's clean development mechanism experience and a future pathway (in a free translation from the Portuguese *Redução de emissões de gases de efeito estufa no setor elétrico brasileiro: a experiência do Mecanismo de Desenvolvimento Limpo do Protocolo de Quioto e uma visão futura*). PhD thesis – Energy Graduation Program. University of Sao Paulo, March 2008.

average (electricity) commercialized. The energy price negotiated for Ibirama project was BRL 128/MWh[45].

It should be added that Ibirama will participate in the Energy Reallocation Mechanism (directly translation from the Portuguese *Mecanismo de Realocação de Energia – MRE*)[46]. The Energy Relocation Mechanism was created through Decree # 2,655 dated July 2nd, 1998 and was regulated by Resolution # 169, dated May 3rd, 2001.

MRE is based on the energy assured[47] of power plants and acts as a balancing pool, mitigating the hydrologic risks for all power producers' participants considering the geographic diversification, territory length and different hydrological regions of Brazil.

This mechanism transfers the energy from the producers who have excess generation compared to their assured energy to the producers who generated below their energy assured. The energy generated in excess, *i.e.* above the assured energy, is reallocated to other project and cannot be sold in the SPOT market. This energy shall be sold/acquired amongst MRE participants for a symbolic price established by the Superintendence of Energy Generation Services Regulation (in a free translation from the Portuguese *Superintendência de Regulação dos Serviços de Geração – SRG*), which is much lower than that established in the project PPA. For 2009 year, the energy price established by Superintendence of Energy Generation Services Regulation is of BRL 8.18 /MWh[48] (lesser than the energy price required to meet the benchmark or the price established in the project PPA).

Considering information above, in case projects generate above or below the energy assured, such event will in the long term have no significant impact in the project's revenue.

Therefore, an increase in the market energy price to around BRL 134.45/MWh (energy price required to meet the benchmark) is very unlikely to occur and if this occurred, it would not have a significant impact in the project's revenue.

(b) Increase in the project plant load factor (PLF)/energy assured

The plant load factor (PLF) for hydropower plants is based on the installed capacity and energy assured of the project. The energy assured of Ibirama project is 13.92 MW-ave. Considering an increase of 18% in the energy assured to the IRR reaches the benchmark, the energy assured would be 16.42 MW-ave. However, the installed capacity and energy assured of a power plant are not freely determined by project

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[45] To make a reasonable comparison between energy prices (estimated and actual), the energy price negotiated for Ibirama project during the energy auction of the 2007 was adjusted to the investment decision making context based on General Market Price Index.

[46] Please, refer to Normative Resolution nr. 65, dated May 25th, 2004, which establishes the energy assured of the project. This Resolution also states that the energy assured established is destined exclusively to MRE and/or PROINFA. Since Ibirama project was not selected to participate in PROINFA, the energy generated shall be sold/acquired amongst MRE participants.

[47] The energy assured is the quantity of electricity generated by power plants connected to the grid with a guarantee level calculated according to ANEEL criteria. For more information see the "Submódulo 20.1", glossary of technical terms from ONS. Available at: <http://www.ons.org.br>.

[48] Available at: http://www.aneel.gov.br/aplicacoes/noticias_boletim/?fuseaction=boletim.detalharNoticia&idNoticia=196>.

sponsors, but established by ANEEL, considering at least 30 years of historical data regarding the project's river and other rivers, such as river flow data, downstream and upstream levels, unavailability (compulsory and planned). For Ibirama project, the energy assured is established through ANEEL Ordinance # 1,368[49].

In addition, according to the Brazilian legislation[50], the project concession shall be based on the maximum installed power and energy generation of the power plant (the project cannot be inefficient, should be implemented as effectively as possible). Therefore, an increase of 18% in the energy generation is not reasonable in the project context and is not expected to occur.

(c) Reduction in project costs

Costs presented in the project cash flow are based on the project sponsor experience with other small hydropower plant in operation: Antonio Brennand; which results in approximately BRL 3 MM/year (4.38% from total investment). A reduction in the project costs until the IRR reaches the benchmark would result in a decrease of 71% from the estimated O&M costs, *i.e.* an O&M cost of BRL 952 thousand/year. A decrease of 71% is not a reasonable scenario in the context of the project activity and is not expected to occur.

Besides of the O&M assumption is based on the project sponsor experience, this percentage of 4.38% from total investment is in accordance to the report from the Mines and Energy Ministry (from the Portuguese Ministério de Minas e Energia – MME)/Centrais Elétricas Brasileiras S/A – Eletrobrás) "Diretrizes para projetos de Pequenas Centrais Elétricas" (2000). This report suggests the use of 5% from total investment for annual O&M costs for small hydropower plants in Brazil.

(d) Reduction in project investment

Investment presented in the project cash flow is based on the previous experience of the project sponsor (approximately to BRL 75 MM) and can be cross-checked with BNDES Annual Report. A reduction of 17% in the project investments to the IRR reaches the benchmark would result in BRL 62.1 MM approximately. However, project sponsor executes turnkey EPC contracts for Ibirama project, in which costs are fixed and will not vary even if project's investments increase for an unexpected reason.

It is important to mention that real investments in developing countries are usually higher than the original estimative. This may be evidenced from the estimation of construction costs and schedules in developing countries. Using a sample of 125 projects (59 thermal and 66 hydropower) Bacon and Besant-Jones (1998)[51] indicates that although the ratio of actual to estimated cost can be smaller than one (indicating actual investment smaller than estimated), less than 10% of the analyzed projects had investments lower

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[49] ANEEL Ordinance # 1,368, issued on June 27th, 2006. Publicly available information: <http://www.aneel.gov.br/cedoc/dsp20061368.pdf>.

[50] MME Decree # 5,163, dated July 30th, 2004.

[51] R. W. Bacon and J. E. Besant Jones (1998). Estimating construction costs and schedules – Experience with power generation projects in developing countries. Energy Policy, vol. 26, no 4, pp 317-333.

than those forecasted. One of the conclusions is that "*the estimated values were significantly biased below actual values*".

Further confirmation on that is provided by the Brazilian Association for the Small and Medium Electrical Energy Producers (in a free translation form Portuguese *Associação Brasileira dos Pequenos e Médios Produtores de Energia Elétrica - APMPE*,), retained by PPs in order to attain an expert opinion. APMPE's work concludes that the likelihood of higher investments then those previously estimated is probable. In line with the statement of APMPE's president the "Guidance for Small Hydropower Plants Studies and Projects"[52] (in a free translation from the Portuguese *Diretrizes para Estudos e Projetos de Pequenas Centrais Hidrelétricas*) prepared by the a power utility controlled by Brazil federal government (Eletrobrás - Centrais Eletricas Brasileiras S.A.) recommends in its Annex 3 to add 5% on above estimated for unforeseen expenses. PPs state that the estimated costs presented for the project activity do not include any cost for unforeseen expenses.

In fact, actual investment of Ibirama project was of BRL 89 MM[53] approximately and, therefore, an amendment of the financing contract had to be signed in January 2011. The increase in the project investment was mainly due to the elaboration of the environmental studies of Ibirama project required for the licensing process, it was identified endemic specie of bromeliad (*Dyckia ibiramensis*) in the project location. For this reason, many researches/studies were prepared and meetings held together with the local community, Santa Catarina state of attorney, city hall, municipal assembly, national and state environmental agencies, Federal University of Santa Catarina[54], non-governmental organizations (NGOs) and communitarian associations. Observing the precaution principle, project sponsors reviewed the Ibirama project design (Annex 5), in which the project configuration would not affect or impact the specie of bromeliad. This new layout was presented to local stakeholders and other entities involved in the licensing process and was approved[55]. This discussion caused a delay (more than one year) in the licensing process and alterations in the project configuration almost became the implementation of the project unfeasible in the technical aspects, causing a significant increase in the project investments.

In summary, values used in the project cash flow are reasonable considering that they are based on project sponsor's experience and, generally, actual investments are higher than estimated. Therefore, a 17% reduction in project investments is not expected to occur.

All information used in this sensitivity analysis is based on official data and will be presented to DOE at the time of validation.

Outcome: The IRR of the project activity without being registered as a CDM project is below the benchmark, evidencing that project activity is not financially attractive for the investor. The knowledge of the CDM registering benefits was the key points to decision-making to implement the project activity.

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[52]Available at http://www.eletrobras.gov.br/EM_Atuacao_Manuais/default.asp (site accessed on August 5th, 2009).

[53] To make a reasonable comparison between estimated and actual investment, total investment (BRL120 MM) of the project was adjusted to the investment decision making context based on General Market Price Index.

[54] The Federal University of Santa Catarina conducts the Project for Conservation of Rheophytic Species of Dyckia in the Southern region of Brazil (from the Portuguese Projeto de *Conservação de Espécies Reófitas de Dyckia no sul do Brasil*).

[55] History of the licensing process of the project is presented in the technical report # 01/09 issued by the environmental agency of Santa Catarina State. This document was presented to the DOE and is available with project participants under request.

SATISFIED/PASS – Proceed to Step 3

Step 3. Barrier analysis

Not applicable.

Step 4. Common practice analysis
Sub-step 4a. Analyze other activities similar to the proposed project activity:

According to the additionality tool (version 5.2), "*projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc*". Thus, the following criteria were considered in order to choose the projects that are similar to Ibirama:

- ***Country/region:*** Brazil has an extension of 8,514,876.599 square kilometres[56] (with over 4,000 km distance in the North-South as well as in the East-West axis) and 6 distinct climate regions: sub-tropical, semi-arid, equatorial, tropical, highland-tropical and Atlantic-tropical (humid tropical). Considering the distinct climate conditions, precipitation varies from 500 to more than 3,000 mm/year[57]. These varieties of climate obviously have strong influence in the technical aspects related to a small hydropower plant implementation *since meteorological events have strong influence in hydrologic process*[58]*. "Climate affects all major aspects of the electric power sector from electricity generation, transmission and distribution system to consume demand for power"*[59].

  Hydropower plants are so bounded to climate conditions, that the Brazilian electricity generation sector have developed mechanisms to mitigate the related risks – the Energy Reallocation Mechanism (from the Portuguese *Mecanismo de Realocação de Energia – MRE*)[60]. MRE is based on the hydropower plants' assured energy and acts as a balancing pool reducing the electricity production variability caused by hydrologic regimes. Another evidence of the climate regional

[56] Available at: http://www.ibge.gov.br/english/geociencias/cartografia/default_territ_area.shtm.

[57] Public information available at *Instituto Nacional de Metereologia – INMET*'s website. Gráfico de normais climatológicas (1961-1990): <http://www.inmet.gov.br/>.

[58] PINTO, J. A. Climatic indicators study for long term prediction in the river flow of Alto São Francisco basin (in a free translation from the Portuguese *Estudo de indicadores climáticos para a previsão de longo termo de vazões na bacia do Alto São Francisco*). Universidade Federal de Minas Ferais: Belo Horizonte, 2005. Available at: <http://www.smarh.eng.ufmg.br/defesas/20D.PDF>.

[59] VESELKA, T. D. Balance power: A warming climate could affect electricity. Geotimes. Earth, energy and environment news. American Geological Institute: August, 2008. Available at: < http://www.agiweb.org/geotimes/aug08/article.html?id=feature_electricity.html>.

[60] The Energy Reallocation Mechanism was created through Decree # 2,655 dated July 2nd, 1998 and was regulated by the Resolution # 169, dated May 3rd, 2001.

distinctiveness can be noted by the spot price value division into sub-markets (South, Southeast/Midwest, Northeast, and North), known as Settlement Price for the Differences (in a free translation from the Portuguese *Preço de Liquidação das Diferenças - PLD*). It is used to valorize the purchase and the sale of electric power in the short term market.

Nevertheless the climate conditions are not the only distinguishing feature among the several Brazilian regions. The tariff applied for electricity distribution system uses the Distribution System Use Tariff (in a free translation from the Portuguese *Tarifa de Uso do Sistema de Distribuição - TUSD*) which varies depending on the state where the power plant is connected to. TUSD is established by specific regulation provided by ANEEL and has strong impact in the financial analysis of a project. Just for reference, from the second semester of 2009, TUSD in Piauí state was BRL 6.26/kW[61] and Santa Catarina state was BRL 2.13/kW[62].

- It is worth mentioning that each state has a specific environmental agency responsible to determine the technical standards required to obtain all environmental licenses, with regional regulations and distinct administrative process established by each state region.

In addition, hydroelectric projects can differ significantly from each other considering the region to be implemented, climate, topography, availability of transmissions lines, river flow regularity, etc. For those reasons alone it is extremely difficult and not reasonable to compare different hydropower potential and plants. Moreover, hydro-power plants cannot be optimally placed (close to load centers and transmission lines) and easily transferred (moved to a new region where a better tariff is offered) as, for example, modular fossil-fuel-fired (diesel, natural gas) power plants. Differences may be even larger if no big water storage is possible, as in the case of small hydropower plants.

Also, considering the State where Ibirama is located – Santa Catarina State –, it has an extension of 95,346.181 square kilometres[63]. For reference, the average of European countries areas is 163,003 square kilometres[64]. This demonstrates that, Santa Catarina is considered large and physical and climatological differences can influence the implementation of small hydropower plants. However, project participants decided to analyze projects located in the same state of the proposed project activity for conservativeness reasons.

Therefore, when evaluating the different climate conditions of each region, the specific environmental regulatory framework of each state, the energy price subdivision per markets and different values of TUSD applied at each Brazilian state, it's clear that the National territory does not consist of the same "comparable environments" as required by the "Tool for the demonstration and assessment of additionality".

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[61] ANEEL Resolution # 871 issued on August 25th, 2009. Available at: < http://www.aneel.gov.br/cedoc/reh2009871.pdf >.

[62] ANEEL Resolution # 848 issued on July 14th, 2009. Available at: < http://www.aneel.gov.br/cedoc/reh2009848.pdf >.

[63] Public information available at IBGE's website: <http://ibge.gov.br/>.

[64] Data collected from United Nations Economic Commission for Europe (UNECE) – UNECE member countries in figures: country overview y indicator, country and year. In this result, the Russian Federation area is not considered. Available at: <http://www.unece.org/>.

Considering information above, only small hydropower plants located in the same region of Ibirama project – Santa Catarina State – were analyzed.

- ***Scale:*** As mentioned in section A, according to the Brazilian regulations, small scale hydropower plants are defined as plants with an installed capacity within 1 and 30MW[65]. Therefore, no large scale hydropower plants (*i.e.* installed capacity over 30MW) were considered. Furthermore, only plants with installed capacity 50% lower and 50% higher than Ibirama project were analyzed (*i.e.* above 10.5 MW)[66].
- ***Same environment with respect to regulatory framework*:** Until the beginning of the 1990's, the energy sector was composed almost exclusively of state-owned companies. From 1995 onwards, due to the increase in international interest rates and the lack of state investment capacity, the government started the privatization process. However, by the end of 2000 results were still modest. Although further initiatives, aiming to improve electric generation in the country, were taken between the 1990's and 2003, they did not attract new investment to the sector. In 2003, the recently elected government decided to fully review the electricity market institutional framework in order to boost investments in the electric energy sector. Market rules were changed and new institutions were created such as Energetic Research Company (in a free translation from the Portuguese *Empresa de Pesquisa Energética – EPE*) – an institution responsible for the long term planning of the electricity sector with the role of evaluating, on a perennial basis, the safety of the supply of electric power – and Chamber for the Commercialization of Electric Power (CCEE) – an institution responsible for the management of electric power commercialization within the interconnected system. This new structure was approved by the House of Representatives and published in March of 2004[67]. Given the new *regulatory framework*, PPs considered only projects started after March of 2004.
- ***Same environment with respect to investment climate, access to technology and financing*:** As mentioned in item "country/region" above, depending on the project location, differences related to the technical aspects of small hydropower plant projects have influence in their implementation, even if small hydro projects are located in the same region. Considering that these technical differences obviously have an influence in the investment/financing of a project and project sponsors have different investment capacity, financial information should be considered when small hydro projects were analyzed. As financial information of similar projects is not accessible for PPs, these projects should be excluded from this analysis following the additionality tool. However, PPs decided to do their upmost in making a reasonable comparison for the purpose of common practice analysis even without investment information available.

Considering the criteria mentioned above, PPs researched generating units of small hydro power plants in Brazil that started operations from April 2004 to December 2010 (the most recent data available until the

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[65] *ANEEL – Agência Nacional de Energia Elétrica. Resolution # 652, issued on December 9th, 2003.*

[66] This range was deemed acceptable by the Board as per the request for review of the CDM Project Activity Ref.# 2010. Document is available at <http://cdm.unfccc.int/Projects/DB/TUEV-SUED1218108477.61/Review/0TR4ZO639HTMUB7EMY2AYRD5BSWR0I/display>.

[67] http://www.planalto.gov.br/CCIVIL/_Ato2004-2006/2004/Lei/L10.848.htm.

elaboration of this PDD) in Santa Catarina State. Also small hydropower plants that received some kind of incentive (PROINFA[68] and/or CDM) were identified.

Table 5 – Operations start of SHPPs from 2004 to 2010

Operation start	Project	Installed power (MW)	Incentive
2004	-		
2005	-		
2006	-		
2007	Flor do Sertão	16.5	Proinfa
	Ludesa	30.0	
	Santa Laura	15.0	
2008	Alto Benedito Novo I	15.0	CDM
	Alto Irani	21.0	Proinfa
	Plano Alto	16.0	
2009	Rodeio Bonito	14.7	CDM
2010	Angelina	26.3	
	Arvoredo	13.0	

Source: ANEEL (2011)[69], UNFCCC (2011)[70] and Eletrobrás (2011)[71]

Spreadsheet with complete research of the common practice analysis is available with the PPs and will be presented to DOE during validation.

68 Alternative Electricity Sources Incentive Program (in a free translation from the Portuguese *Programa de Incentivo às Fontes Alternativas de Energia Elétrica – PROINFA*), created through the Law # 10,438 dated April 26th, 2002. Among others, one of the initiative's goals is to increase the renewable energy sources share in the Brazilian electricity market, thus contributing to a greater environmental sustainability. In order to achieve such goals, the Brazilian government has designated the federal state-owned power utility Eletrobrás (Centrais Elétricas Brasileiras S/A) to act as the primary off-taker of electric energy generated by alternative energy facilities in Brazil, by entering into long-term Power Purchase Agreements with alternative energy power producers, at a guaranteed price of at least 80% of the average energy supply tariff charged to ultimate consumers. Also, the Brazilian Decree # 5,025 dated March 30th, 2004, which regulates the Law # 10,438, states that PROINFA aims for the reduction of greenhouse gases as established by the United Nations Framework Convention on Climate Change (UNFCCC) under Kyoto Protocol, contributing to the sustainable development. Therefore, the program is clearly a "Type E-" policy.

69 ANEEL (2011). Follow up of small hydropower projects with the Constructon License issued (from the Portuguese *Resumo Geral do Acompanhamento das Usinas de Geração Elétrica*) – version March 2011. Banco de Informações de Geração (BIG). Agência Nacional de Energia Elétrica. Available at: <http://www.aneel.gov.br/>.

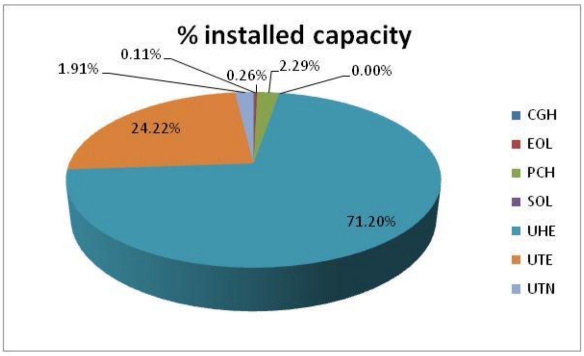
70 UNFCCC (2011). Project Activities. Validation. United Nations Framework Convention on Climate Change. Available at <http://cdm.unfccc.int/index.html>. Accessed on March 21st, 2011.

71 ELETROBRÁS (2011). Centrais Elétricas Brasileiras S/A. Programs and setorial funds. Proinfa. Contracted projects and addendum signed (from the Portuguese *relação de empreendimentos contratados e extratos de contratos e termos aditivos celebrados*). Available at: <http://www.eletrobras.com/elb/data/Pages/LUMISABB61D26PTBRIE.htm>. Accessed on March 21st, 2011.

Sub-step 4b. Discuss any similar options that are occurring:

Considering research above, all projects that have started operation since April 2004 publicly receive some kind of incentive (CDM and/or PROINFA). This result demonstrates that risks related to this type of project are higher, as discussed in Step 2 – Investment Analysis, and that a strong incentive is required to promote the construction of renewable energy projects in Brazil, where it includes small hydropower plants.

It is worth mentioning that 71.2 % of Brazil's generation is composed of large hydro and 24.22 % of thermal power stations. Only 2.29 % of Brazil's installed capacity comes from small hydro power sources (2.6 GW out of a total of 105.65 GW).



Legend	
CGH	Hydroelectric Generator Center
CGU	Undi-Eletric Generator Center
EOL	Wind Generator Center
PCH	**Small Hydroelectric Power Plant**
SOL	Solar Generation Center Photovoltaic
UHE	Hydroelectric Power Plant
UTE	Thermoelectric Power Plant
UTN	Thermonuclear Power Plant

Figure 4 – Share of installed capacity

Source: ANEEL (2008)[72]

Moreover, in the most recent energy auctions, which took place between 2005 and 2007, from the total of 9,594 MW sold, 5,888 MW (61.3%) will come from fossil fuel fired thermal power plants, from which 2,152 MW come from natural gas and 2,514 MW fuel oil fired thermal power plants, *i.e.*, 22.4% and 26.2% of the total sold respectively[73].

In summary, this project activity is clearly not common practice, because no similar project started operation during the above mentioned period without some kind of incentive. With the financial benefit derived from the CERs, it is anticipated that other project developers will benefit from this new source of

[72] ANEEL (2008). Energy generation database (from the Portuguese *Banco de Informações de Geração – BIG*). Brazil's generation capacity. Brazilian Power Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica*). Available at: <http://www.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.asp>.

[73] ESPARTA, A. R. J. (2008). Greenhouse gases emission reductions in the Brazilian power sector: Kyoto Protocol's clean development mechanism experience and a future pathway (in a free translation from the Portuguese *Redução de emissões de gases de efeito estufa no setor elétrico brasileiro: a experiência do Mecanismo de Desenvolvimento Limpo do Protocolo de Quioto e uma visão futura*). PhD thesis – Energy Graduation Program. University of Sao Paulo, March 2008.

revenue and further will decide to develop such projects. CDM has made it possible for investors to set up their small hydro plants and sell their electricity to the grid.

SATISFIED/PASS – Project is ADDITIONAL

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

ACM0002 - "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" was chosen. The chosen methodology is applicable to grid-connected renewable power generation projects, under the condition of electricity capacity additions from run-of-river hydro power plants, as is the case of Ibirama project.

Emission reductions calculation (ER_y)

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

$$ER_y = BE_y - PE_y - LE_y \qquad \textbf{Equation 1}$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr);

BE_y = Baseline emissions in year y (tCO_2e/yr);

PE_y = Project emissions in year y (tCO_2e/yr);

LE_y = Leakage emissions in year y (tCO_2e/yr).

Baseline emissions calculation (BE_y)

Baseline emissions are calculated using the annual generation (project annual electricity dispatched to the grid) times the CO_2 average emission rate of the estimated baseline, as follows:

Monitored project power generation	(MWh)	(A)
Baseline emission rate factor	(tCO_2/MWh)	(B)
(A) x (B)	(tCO_2)	

The emission reductions by the project activity (ER_y) during a given year y are achieved through the equation below:

$$BE_y = EG_{PJ,y} \times EF_{grid,CM,y}$$ **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);

$EF_{grid,CM,y}$ = 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).

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

According to the selected approved methodology (ACM0002, 2009), the baseline emission factor (EF_y) is calculated using the methodological tool "Tool to calculate the emission factor for an electricity system". According to this tool PPs shall apply the following six steps to the baseline calculation:

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

According to the tool, "*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. If such delineations are not available, project participants should define the project electricity system and any connected electricity system and justify and document their assumptions in the CDM-PDD*".

Brazilian DNA has published the Resolution # 8 issued on 26th May, 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). Hence, this figure will be used to calculate the baseline emission factor of the grid.

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

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option (i): only grid power plants are included in the calculation;

Option (ii): both grid power plants and off-grid power plants are included in the calculation.

The Brazilian DNA made available the emission factor calculation based on information of the grid power plants only – option (i) – following the "*Tool to calculate the emission factor for an electricity system*". More information of the methods applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/4016.html).

- **STEP 3 -** Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) is based on one of the following methods:

(a) Simple OM, or

(b) Simple adjusted OM, or

(c) Dispatch data analysis OM, or

(d) Average OM.

The Brazilian DNA made available the operating margin emission factor calculated following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. The calculation uses option c – Dispatch data analysis OM. This option does not permit the vintage of *ex-ante* calculation of the emission factor. Therefore, the chosen option was ***ex-post*** calculation. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. More information of the methods applied can be obtained in the DNA's website (http://www.mct.gov.br/index.php/content/view/4016.html) and vintage will be used in the project activity.

- **STEP 4 -** Calculate the operating margin emission factor according to the selected method

The dispatch data analysis OM emission factor ($EF_{grid,OM\text{-}DD,y}$) is determined based on the power units that are actually dispatched at the margin during each hour *h* where the project is displacing electricity. This approach is not applicable to historical data and, thus, requires annual monitoring of $EF_{grid,OM\text{-}DD,y}$.

It will be calculated using the below formulae:

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

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 the year *y* (MWh);

$EF_{EL,DD,h}$ = CO_2 emission factor for power units in the top of the dispatch order in hour *h* in year *y* (tCO_2/MWh);

$EG_{PJ,y}$ = Total electricity displaced by the project activity in year *y* (MWh);

h = Hours in year *y* in which the project activity is displacing grid electricity;

y = Year in which the project activity is displacing grid electricity.

As mentioned above, the host country's DNA will provide $EF_{EL,DD,h}$ in order for PPs to calculate the operating margin emission factor. Hence, this data will be updated annually applying the number published by the Brazilian DNA. For estimation purposes, the data of the most recent year available in the DNA website will be used.

- **STEP 5 -** Calculate the build margin (BM) emission factor

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:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$ **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);

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

The Brazilian DNA made available the build margin emission factor calculated following the "Tool to calculate the emission factor for an electricity system", approved by the CDM Executive Board. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. The number is published on the website and for estimation purposes the data for the most recent year will be used.

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

The combined margin is calculated as follows:

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y}$$ **Equation 5**

Where:

w_{OM} = weighting of operating margin emissions factor (%);

$EF_{OM\,y}$ = Operating margin CO_2 emission factor in year y (tCO_2/MWh);

w_{BM} = weighting of build margin emissions factor (%);

$EF_{BM,\,y}$ = Build margin CO_2 emission factor in year y (tCO_2/MWh).

Weights are determined by the emission factor calculation tool. Alternative weights can be proposed for consideration by the Executive Board, as long as $w_{OM} + w_{BM} = 1$, and the values applied by PPs should be fixed for a crediting period and may be revised at the renewal of the crediting period.

Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity ($EG_{PJ,y}$)

According to ACM0002, the calculation of $EG_{PJ,y}$ is different depending on the case of the project as follows:

(a) Greenfield plants (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);

(b) Retrofits and replacements of an existing renewable energy power plant;

(c) Capacity addition to an existing renewable energy power plant.

Since Ibirama project is a new hydropower plant connected to the grid where no renewable power plant was operated prior to the project, Ibirama applies option (a). In this case, $EG_{PJ,y}$ is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y}$$ **Equation 6**

Where:

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

Estimated quantity of net electricity generation supplied by the project plant/unit to the grid is presented in section B.6.3 below.

Project emissions calculation (PE_y)

The proposed project activity may involve project emissions that can be significant. In this sense, according to the selected CDM methodology these emissions shall be accounted for as project emissions by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ **Equation 7**

Where:

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

$PE_{FF,y}$ = Project emissions from fossil fuel consumption in year *y* (tCO2/yr);

$PE_{GP,y}$ = Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (tCO2e/yr);

$PE_{HP,y}$ = Project emissions from water reservoirs of hydro power plants in year *y* (tCO2e/yr).

Emissions from fossil fuel combustion ($PE_{FF,y}$)

Considering that there is no fossil fuel combustion in the proposed project activity, $PE_{FF,y}$ = 0 tCO_2/year.

Emissions from the operation of geothermal power plants due to the release of non-condensable gases ($PE_{GP,y}$)

Considering that the proposed project activity consists on the construction of a small hydropower plant, there are no emissions of non-condensable gases from the operation of geothermal power plants. Therefore, $PE_{GP,y}$ = 0 tCO_2/year.

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

According to ACM0002, new hydro electric power projects with reservoirs, shall account for project emissions, estimated as follows:

a) If the power density (*PD*) of power plant is greater than 4 W/m^2 and less than or equal to 10 W/m^2:

$$PE_y = \frac{EF_{Res} \times TEG_y}{1000}$$ **Equation 8**

Where:

PEy = Emission from reservoir expressed as tCO_2e/year;

EF_{Res} = is the default emission factor for emissions from reservoirs, and the default value as perEB23 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).

b) If power density (*PD*) of the project is greater than 10W/m^2, PEy = 0. The power density of the project activity is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \qquad \textbf{Equation 9}$$

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.

Leakage calculation (LE_y)

Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless, no significant net leakage from these activities was identified.

B.6.2. Data and parameters that are 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.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methodology that this value shall be applied for new hydro power plants.
Any comment:	

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity.
Source of data used:	Project site
Value applied:	0
Justification of the choice of data or description of measurement methods and procedures actually applied:	The methodology that this value shall be applied for new hydro power plants.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Emission reductions calculation (ER_y)

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

$$ER_y = BE_y - PE_y - LE_y \qquad \textbf{Equation 1}$$

Baseline calculation (BE_y)

As described in section B.6.1, baseline calculation (*BE*) in this project are calculated directly from electricity supplied by the project to the grid (*EG*) multiplied by the emission factor (*EF*).

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

For the estimated purposes, emission factor data provided by the Brazilian DNA for the years 2006, 2007 and 2008 was applied. When applying the published numbers in the formula presented in step 3 of section B.6.1., the $EF_{grid,OM-DD,y}$ obtained was:

$$EF_{grid,OM-DD,\ 2006-2008} = 0.3636\ tCO_2e/MWh.$$

The building margin average for the years 2006, 2007 and 2008 published by the DNA is:

$$EF_{BM,\ 2006-2008} = 0.1016\ tCO_2e/MWh.$$

With these numbers, applying in the formula presented in step 6 of section B.6.1., we have:

$$EF_y = 0.5 \times 0.3636 + 0.5 \times 0.1016$$

$$EF_y = 0.2326\ tCO_2e/MWh.$$

Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity ($EG_{PJ,y}$)

As mentioned in section B.6.1, $EG_{PJ,y} = EG_{facility,y}$. Estimated quantity of net electricity generation supplied by the project plant/unit to the grid is calculated based on the ANEEL Resolution # 65, dated May 25th, 2004, *i.e.*, 121,939 MWh/year.

In addition, the ANEEL Ordinance # 1,368, issued on June 27th, 2006, states that the energy assured of the project is 13.92 MW-ave. Therefore, the plant load factor (PLF) of the project is 66% (13.92 MW-ave ÷ 21 MW = 66%). Considering the 8,760 hours of operation in the year, the energy delivered to the grid is 121,939.2 MWh, being according to the ANEEL Resolution # 65 mentioned above.

Considering explanations above, Ibirama project applies option (a) of the "Guidelines for the reporting and validation of plant load factors", *i.e.* "*the plant load factor provided to banks and/or equity financiers while applying the project activity for project financing, or to the government while applying the project activity for implementation approval*".

Project emissions calculation (PE_y)

Emissions from fossil fuel combustion ($PE_{FF,y}$)

Considering that there is no fossil fuel combustion in the proposed project activity, $PE_{FF,y} = 0\ tCO_2/year$.

<u>Emissions from the operation of geothermal power plants due to the release of non-condensable gases ($PE_{GP,y}$)</u>

Considering that the proposed project activity consists on the construction of a small hydropower plant, there are no emissions of non-condensable gases from the operation of geothermal power plants. Therefore, $PE_{GP,y} = 0$ tCO_2/year.

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

According to ACM0002, new hydro electric power projects with reservoirs, shall account for project emissions based on its power density (PD):

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ **Equation 7**

Considering Ibirama project data: Cap_{PJ} = 21 MW; Cap_{BL} = 0; A_{PJ} = 0.13 km^2 and A_{BL} = 0 km^2, the *PD* is 161.6 MW/km^2 or 161.6 W/m^2. As Ibirama power density (*PD*) is greater than 10 W/m^2, PE_y is 0 tCO_2/year.

<u>Leakage calculation (LE_y)</u>

Indirect emissions can result from project construction, transportation of materials and fuel and other upstream activities. Nevertheless, no significant net leakage from these activities was identified.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Table 7- Estimated emission reductions of the project

Years	**Estimation of project activity emissions** (tonnes of CO_2e)	**Estimation of baseline emissions** (tonnes of CO_2e)	**Estimation of leakage** (tonnes of CO_2e)	**Estimation of overall emission reductions** (tonnes of CO_2e)
Year 1 - (2012)*	0.00	14,065	0.0	14,065
Year 2 - (2013)	0.00	28,363	0.0	28,363
Year 3 - (2014)	0.00	28,363	0.0	28,363
Year 4 - (2015)	0.00	28,363	0.0	28,363
Year 5 - (2016)	0.00	28,363	0.0	28,363
Year 6 - (2017)	0.00	28,363	0.0	28,363
Year 7 - (2018)	0.00	28,363	0.0	28,363
Year 8 - (2019)**	0.00	14,298	0.0	14,298
Total (tonnes of CO_2e)	**0.00**	**198,541**	**0.00**	**198,541**

*Starting on July 1st
**Until June 30th

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Electricity generation of the Project delivered to grid.
Source of data:	Project activity site.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	121,939 Estimated energy dispatched to the grid based on the ANEEL Resolution # 65, issued on May 25th, 2004.
Description of measurement methods and procedures to be applied:	Continuously measurement and monthly recording. Double checked by internal control and sales receipt or by documents from the Chamber of Electric Energy Commercialization (from the Portuguese *Câmara Comercializadora de Energia Elétrica – CCEE*). Electronically archived.
QA/QC procedures to be applied:	Equipments used have by legal requirements extremely low level of uncertainty).
Any comment:	-

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.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	21,006,000 Sum of the nominal power of the three generators used in the project as requested by DOE. Detailed information is presented in CL 14 of the Validation Protocol. The project licenses and the authorizations issued by the Brazilian Power Regulatory Agency (in a free translation from the Portuguese *Agência Nacional de Energia Elétrica – ANEEL*) also indicate 21 MW of installed capacity for Ibirama project.

	Source of information was taken from the design data sheet issued by the Voith Siemens (turbine manufacturer) dated October 1st, 2007.
Description of measurement methods and procedures to be applied:	Installed capacity of the power plant will be checked by DOE during verification on-site visit. TAG's equipment and licenses issued by the Environmental Agency of the State will be available at that time. Electronically archived.
QA/QC procedures to be applied:	-
Any comment:	-

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:	Construction License nr. 0013/09 (issued on 18/02/2009).
Value of data applied for the purpose of calculating expected emissions reductions in section B.5	130,000
Measurement procedures (if any):	The reservoir are will be monitored through topographical data in the location of the project activity (made once at the time of the project design) and the reservoir level, which will yearly monitored by project sponsor. Electronically archived.
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EF_{grid.CM.y}$
Data unit:	tCO_2/MWh
Description:	Combined margin CO_2 emission factor for grid connected power generation in year *y*
Source of data to be used:	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in	0.2326

section B.5	
Description of measurement methods and procedures to be applied:	Calculated based on Operating and Build margin emission factors. Electronically archived.
QA/QC procedures to be applied:	-
Any comment:	For estimative purpose, the average of 2006, 2007 and 2008 was used.

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 used:	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.3636
Description of measurement methods and procedures to be applied:	The selected option to calculate the operating margin was the dispatch analysis which does not permit the vintage of *ex-ante* calculation of the emission factor. Therefore. the chosen option was ***ex-post*** calculation. This parameter will be annually up-dated applying the numbers provided by the Brazilian DNA. Electronically archived.
QA/QC procedures to be applied:	
Any comment:	For estimative purpose, the average of 2006, 2007 and 2008 was used.

Data / Parameter:	$EF_{grid.BM.y}$
Data unit:	tCO_2/MWh
Description:	Build 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 used:	Calculated following the steps provided by the "Tool to calculate the emission factor for an electricity system" applying the numbers published by the Brazilian DNA website: (http://www.mct.gov.br/index.php/content/view/4016.html)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.1016
Description of measurement methods and procedures to be applied:	Option 2 of the tool was chosen. Hence. this parameter will be ***ex-post*** up-dated applying the numbers provided by the Brazilian DNA. Electronically archived.
QA/QC procedures to be applied:	
Any comment:	For estimative purpose, the average of 2006, 2007 and 2008 was used.

Data / Parameter:	$FC_{i,m,y}$, $FC_{i,y}$, $FC_{i,j,y}$, $FC_{i,k,y}$, $FC_{i,n,y}$ ***and*** $FC_{i,n,h}$
Data unit:	Mass or volume unit
Description:	Amount of fossil fuel type i consumed by power plant / unit *m*, *j*, *k* or *n* (or in the project electricity system in case of $FC_{i,y}$) in year *y* or hour *h*
Source of data used:	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the "Tool to calculate the emission factor for an electricity system".
Description of measurement methods and procedures to be applied:	Data monitored yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$NCV_{i,y}$

Data unit:	GJ/ mass or volume unit
Description:	Net calorific value (energy content) of fossil fuel type *i* in year *y*
Source of data used:	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the "Tool to calculate the emission factor for an electricity system".
Description of measurement methods and procedures to be applied:	Data monitored yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	$EF_{CO2i,y}$ ***and*** $EF_{CO2m,i,y}$
Data unit:	tCO_2/GJ
Description:	CO2 emission factor of fossil fuel type *i* in year *y*
Source of data used:	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the "Tool to calculate the emission factor for an electricity system".
Description of measurement methods and procedures to be applied:	Data monitored yearly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	***$EG_{m,y}$, EG_y, $EG_{j,y}$, $EG_{k,y}$ and $EG_{n,h}$***
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant / unit *m*, *j*, *k* or *n* (or in the project electricity system in case of EG_y) in year *y* or hour *h*
Source of data used:	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the “Tool to calculate the emission factor for an electricity system”.
Description of measurement methods and procedures to be applied:	Data monitored hourly.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	***$EG_{PJ,h}$***
Data unit:	MWh
Description:	Electricity displaced by the project activity in hour *h* of year *y*
Source of data used:	Brazilian DNA (Comissão Interministerial de Mudança Global do Clima – CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the “Tool to calculate the emission factor for an electricity system”.
Description of measurement methods and procedures to be applied:	Data monitored hourly.
QA/QC procedures to be	

applied:	
Any comment:	

Data / Parameter:	$\eta_{m,y}$
Data un t:	-
escript on:	Average net energy conversion efficiency of power unit *m* in year *y*
Sour e of data used:	Brazilian DNA (Comissão Interminist rial de Mudança Glob l do Clima CIMGC)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Calculated by the Brazilian DNA according to the “Tool to calculate the emission factor for an electricity system”.
Description of measurement methods and procedures to be applied:	Data monitored yearly.
QA/QC procedures to be applied:	
Any comment:	

B.7.2 Description of the monitoring plan:

The project activity will proceed according to the “Approved consolidated monitoring methodology ACM0002” – “Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources”. According to this methodology and as presented in this PDD, the parameters to be monitored for Ibirama 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 reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (A_{PJ});

(iv) Parameters used for the calculation of 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" ($EF_{grid,CM,y}$).

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

The electricity monitoring consists of using a meter equipment projected to register and verify bidirectionally the energy generated by the facility. This energy measurement is fundamental to verify and monitor the baseline emissions.

There will be six energy meters involved in the project activity: 3 located in each generator, 1 meter (which writes up the total sum of generator meters) and 2 at the substation (principal and backup). Energy meters that will be used have by legal requirements extremely low level of uncertainty. See meters specifications in Table 10.

Measurements will be controlled in real time by the Operation and Management Center (from the Portuguese *Centro de Operação de Geração – COG*) in Cuiabá, capital of Mato Grosso State. For emission reductions, monthly recording from the local power utility or Chamber of Electric Energy Commercialization (from the Portuguese Câmara Comercializadora de Energia Elétrica – CCEE) will be used.

Meters located at the plant will measure the gross electricity and meters located at the substation will measure the net electricity of Ibirama project. The net measurement will be used for invoicing and, also, for emission reduction purposes. The gross measurements are only for internal control and cross-checking data, in case of large discrepancies (losses share).

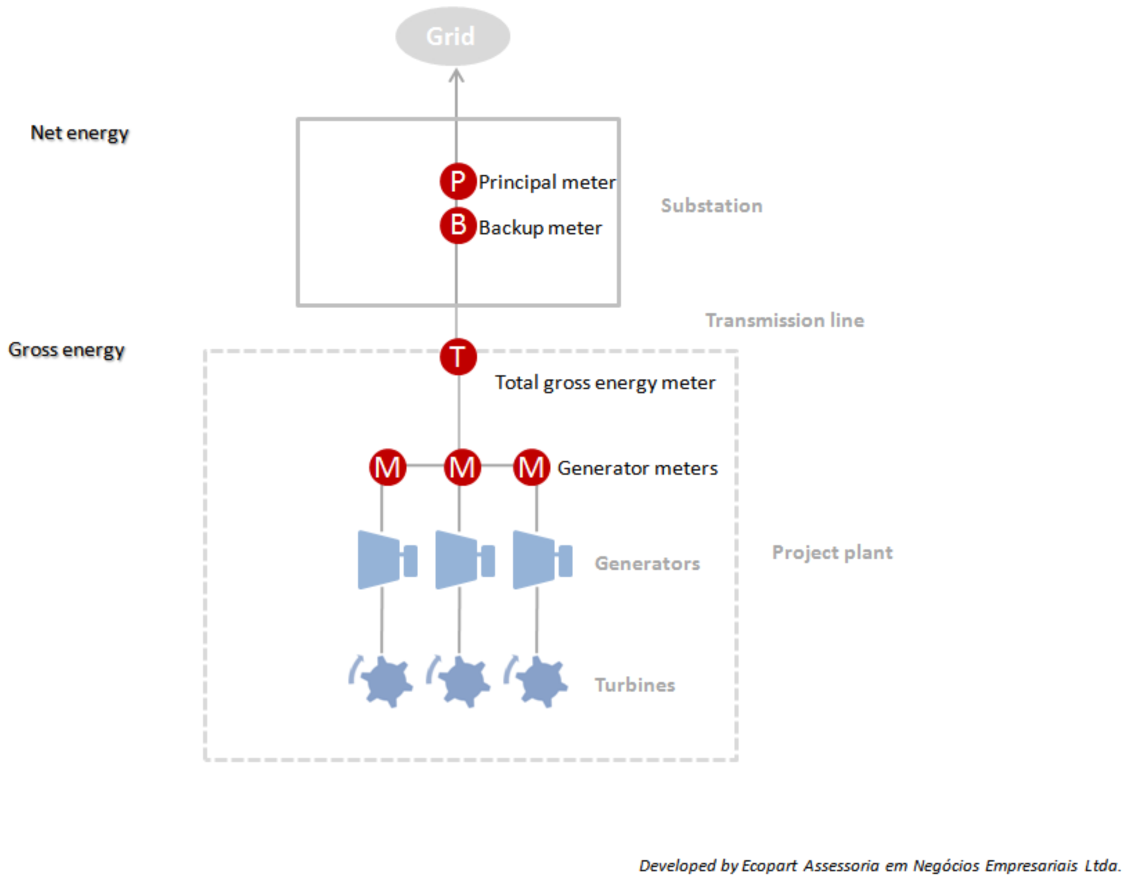


Figure 4 – Meters diagram involved in the project activity

It is important to mention that meters located in the substation have to be the ones specified by the Chamber of Electric Energy Commercialization (from the Portuguese *Câmara de Comercialização de Energia Elétrica - CCEE*). CCEE makes feasible and regulates the electricity energy commercialization. Before the operations start, CCEE demands that these meters are calibrated by an entity with Rede Brasileira de Calibração (RBC) credential. In addition, CCEE will have online access to the measurement data from the meters located at the substation.

Table 10 – Meters specifications

Type	SAGA 1000[74]	IDM144[75]
Class	0.2	0.25 - 0.5
Frequency	50/60 Hz	50/60 Hz
Manufacturer	Landis+Gyr Equipamentos de Medição Ltda.	ABB Ltda.
Location	Principal and backup meters at the substation (P/B)	At the generators and power plant (T, M)

Centrais Elétricas de Santa Catarina S/A (CELESC) will be responsible for the calibration each 2 years of meters located at the substation, following the ONS procedures (procedure 12.3)[76].

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

Installed capacity of the power plant will be checked by DOE during on-site visit at every verification (estimated to happen yearly) and cross-checked with official documents, *e.g.* new ANEEL resolutions/authorization or new licenses issued by the environmental agency of Santa Catarina State.

Since power plants are only authorized to export electricity based on the installed capacities approved by the Brazilian Power Regulatory Agency (ANEEL) and the environmental agencies of the states, changes in the installed capacity of the project can be clearly identified (low level of uncertainty).

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

The reservoir area of the project will be monitored through topographical studies (made once at the time of the project design) and water reservoir levels, which will be monitored monthly by the

[74] As mentioned above, meters located at the substation have to be the ones specified by CCEE. Therefore, SAGA1000 meter has the necessary requirements to be used in the Ibirama project as presented at the CCEE's website: <http://www.ccee.org.br/cceeinterdsm/v/index.jsp?vgnextoid=ca4da5c1de88a010VgnVCM100000aa01a8c0RCRD>. Specifications of SAGA1000 meter can be checked in the manufacturer's manual dated April 20th, 2006, as presented to the DOE during validation.

[75] Specifications of IDM144 meter can be checked in the manufacturer's manual dated 2000, as presented to the DOE during validation.

[76] ONS procedure 12.3. Maintenance of the metering system for invoicing. Grid procedures. Version 1. Valid since August 5th, 2009. Available at: <http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.3_Rev_1.0.pdf>.

project sponsors (plant operator). This information will be available at the time of the project verification (estimated to happen yearly).

Brazilian government does not require the reservoir area monitoring; the reservoir area of a small or large hydropower plant in Brazil is determined once at the time of the project design/conception, Project Participants considered the reservoir area a parameter that does not require to be monitored (see Project Participants response in the Validation Protocol).

(iv) Parameters used for the calculation of 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” ($EF_{grid,CM,y}$).

The Brazilian DNA will made publicly available the build margin ($EF_{grid.BM.y}$) and operating margin ($EF_{grid.OM.y}$) emission factors yearly. Then, these values will be used at the time of the project verification.

Brennand Group will be responsible for the project management, as well as for organising and training the staff in the appropriate monitoring, measurement and reporting techniques. Also, Brennand Group is preparing an operation, maintenance and emergency manual. Technicians will be trained on mounting and start-up.

In addition, Brennand Group will be responsible for the maintenance of the monitoring equipment, 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.

It is important to mention that ANEEL can visit the plant to inspect the operation and maintenance of the facility.

Brennand Group, the company that controls Ibirama Energética S.A., has hired expert companies to execute their environmental programs. After the beginning of commercial operations, renovation of degraded areas and of permanent preservation areas will be done according to the regulations of the environmental agencies, through a team of environmental experts, that will also monitor 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 to be adopted during the construction phase. These measures are being taken rigorously. Data about environmental impact are being archived by the SHPPs and the environmental agencies.

Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completing the final draft of this baseline section and the monitoring methodology (DD/MM/YYYY): 22/05/2009.

Name of person/entity determining the baseline:

Company: Ecopart Assessoria em Negócios Empresariais Ltda.
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Country: Brazil
Telephone number: +55 (11) 3063-9068
Fax number: +55 (11) 3063-9069
E-mail: info@eqao.com.br

Ecopart Assessoria em Negócios Empresariais Ltda. is Project Advisor and Project Participant.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

(DD/MM/YYYY) 31/08/2007. This date corresponds to the date in which the first order of the main equipment happened, *i.e.*, when project sponsors committed expenditures related to the project activity representing the first real action for the project implementation, following the 41st CDM EB Meeting Report. See section B.5 (i) “definition of the project start date” of this PDD.

C.1.2. Expected operational lifetime of the project activity:

23y-1m

According to ANEEL Resolution # 24, issued on January 27th, 2004, Art 7, the project concession is valid for 30 years from the issuance of this Resolution. Therefore, the period of 30 years also includes the project design/study and construction, *i.e.*, the project lifetime is from 2004 to 2034. Since the project started operations in the end of December 2010, the estimated project lifetime is 23 years and 1 month.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

(DD/MM/YYYY) 01/07/2012 or on the date of registration of the CDM project activity, whichever is later.

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

Not applicable.

C.2.2.2. Length:

Not applicable.

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

In Brazil, the sponsor of any project that involves construction, installation, expansion or operation of any polluting or potentially polluting activity or any other capable to cause environmental degradation is obliged to secure a series of permits from the relevant environmental agency (federal and/or local, depending on the kind of project and location).

The environmental impact of the Project is considered small by the host country definition of small-hydro plants. By legal definition of the Brazilian Electricity Regulatory Agency (ANEEL), Resolution # 652, dated December 9th, 2003, small hydro in Brazil must have installed capacity greater than 1 MW but not more than 30 MW and with reservoir area less than 3 km², but not greater than 13 km².

Although environmental impacts of small hydro power plants construction are considered small given the smaller dams and reservoir area size, project sponsors have to obtain all licenses as required by the National Environmental Council (from the Portuguese *Conselho Nacional do Meio Ambiente – CONAMA*) Resolution # 237 dated December 19th, 1997:

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

Accordingly to article 3 of this Resolution and Complementary Law # 38 dated November 21st, 1995, in order to issue licenses, the Environmental Impact Study (from the Portuguese *Estudo de Impacto Ambiental – EIA*) and the Environmental Impact Report (from the Portuguese *Relatório de Impacto Ambiental – RIMA*) are required for hydropower projects with installed capacity greater than 10 MW. However, according to the article 12 of CONAMA Resolution # 237, the competent entity shall evaluate the significance of impact of the project implementation and the types of studies required for each project:

- EIA/RIMA (mentioned above) or;
- Simplified Environmental Report (from the Portuguese *Relatório Ambiental Simplificado – RAS*).

These reports shall be made public available to local stakeholders and public entities. Furthermore, according to the CONAMA Resolution # 1 dated January 23rd, 1986, the environmental agency is responsible to issue licenses and decide the necessity in making public consultations and forums for the project implementation. When public consultation is required, it usually happens in parallel with the Preliminary License issuance.

After the Preliminary License issuance, the environmental agency requires a report containing environmental and social programs to be implemented aiming the mitigation of impacts caused by the project construction (from the Portuguese "*Projeto Básico Ambiental – PBA"*). If PBA is approved by the environmental agency, the Construction License is issued. Then, the power plant construction is authorized and can be started.

In the case of Ibirama project, PBA presents 14 environmental programs, which were approved by FATMA and, therefore, the Construction License was issued considering the 14 programs mentioned in the project PBA as conditionings for the validity of the license.

In parallel with the power plant construction, programs described in the PBA are implemented and, when the power plant construction finishes, the Operating License is issued.

In order to keep the Operating License valid, many social and environmental requirements have to be quarterly assessed, thus this license is constantly revalidated during the project's lifetime. This ensures that the project continuously meets its environmental obligations and the goals that are established in the project PBA.

The necessary documents and requirements for the licensing process are presented in the CONAMA Resolution # 6, issued on September 16th, 1987.

It is important to mention that besides of the 14 environmental programs that project sponsor are implementing - as presented mentioned in the project PBA and Construction License -, Ibirama Energética S/A also has to ensure 1% of the total costs of the project implementation for the National Conservation Unit System[77] (in a free translation from the Portuguese *Sistema National de Unidade de Conservação – SNUC*). In addition, Ibirama Energética S/A made some donations, not for the fulfillment with the environmental requirements, but to ensure the well being of local communities. One example of the project sponsor contribution is the donation for Instituto Chico Mendes de Conservação da Biodiversidade – Parque Nacional do Iguaçu[78].

[77] See the Construction License of the project # 0013/09, issued on February 18th, 2009.

[78] Contract signed between Ibirama Energética S/A and Instituto Chico Mendes de Conservação da Biodiversidade – Parque Nacional do Iguaçu on July 21st, 2009.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The plant possesses the following licenses issued by the Santa Catarina Environmental Agency (*Fundação do Meio Ambiente* - *FATMA*):

Table 11 – Licenses issued for Ibirama project

Type	Number	Issuance date	Validity
Preliminary	218	08/08/2002	08/08/2004
Construction	013	18/02/2009	18/02/2012
Operation	086	17/12/2010	17/12/2014

The project does not imply in significant negative transboundary environmental impacts, on the contrary the licenses would not be issued. All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FATMA) and with the PPs.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

Brazilian Designated National Authority "*Comissão Interministerial de Mudanças Globais do Clima*", requests comments from local stakeholders, and the validation report issued by an authorized DOE according to the Resolution # 7, issued on March 5th, 2008, in order to provide the Letter of Approval.

The Resolution determines the direct invitation for comments sent by the project proponents at least to the following agents involved in and affected by project activities and at least 15 days before the GSP:

- Municipal governments and City Councils;
- State and Municipal Environmental Agencies;
- Brazilian Forum of NGOs and Social Movements for Environment and Development;
- Community associations;
- State Attorney for the Public Interest (state and federal);

Invitation letters were sent to the following agents (copies of the letters and post office confirmation of receipt communication are available upon request and will be supplied to the DOE validating the Project Activity):

- City Hall of Ibirama;

- Municipal Assembly of Ibirama;
- Environmental Agency of Ibirama;
- Communitarian Association;
- Environmental Agency of Santa Catarina;
- State Attorney for the Public Interest (state and federal);
- Fórum Brasileiro de ONGs e Movimentos Sociais para o Desenvolvimento e Meio Ambiente (Brazilian Forum of NGOs and Social Movements for the Development and Environment).

No concerns were raised in the public calls regarding the project neither in the local (demanded by the DNA) nor in the global stakeholders' process (demanded by the CDM modalities and procedures).

E.2. Summary of the comments received:

In response to the letters sent by the Project Participants regarding the CDM process of Ibirama project, the environmental agency of Santa Catarina State (FATMA) stated that Ibirama project fully attended the environmental requirements of the licensing process so far. This letter is dated May 11th, 2009 and was presented to the DOE during validation; also available with the Project Participants under request.

E.3. Report on how due account was taken of any comments received:

Considering that the comments sent by the environmental agency were positive and no concerns were raised, no response to this letter was sent by the Project Participants.

Annex 1

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in the present project.

This project is not a diverted ODA from an Annex 1 country.

Annex 3

BASELINE INFORMATION

The Brazilian electricity system, for the purpose of CDM activities, was delineated as a single interconnected system comprehending the five geographical regions of the country (North, Northeast, South, Southeast and Midwest). This was determined by the Brazilian DNA through its Resolution # 8 dated May 26th, 2008. The Brazilian DNA has also published the build and operating margin for the Brazilian Interconnected System for the years 2006, 2007 and 2008 (Table 12).

Table 12 – Summary of operating margin (monthly) and build margin (annual) published by the Brazilian DNA

Emission Factor, Combined Margin, Brazilian Interconnected System ($EF_{CM} = 0.5 \times EF_{OM} + 0.5 \times EF_{BM}$) [$tCO_2$/MWh]												
--- 2006 ---	January	February	March	April	May	June	July	August	September	October	November	December
EF_{OM}	0.3218	0.3462	0.3373	0.2752	0.3173	0.3058	0.3507	0.3360	0.3834	0.3598	0.2651	0.2802
EF_{BM}	0.0814											
EF_{CM} (montlhy)	0.2016	0.2138	0.2094	0.1783	0.1993	0.1936	0.2160	0.2087	0.2324	0.2206	0.1732	0.1808
EF_{CM} (annual)	**0.2023**											
--- 2007 ---	January	February	March	April	May	June	July	August	September	October	November	December
EF_{OM}	0.2292	0.1954	0.1948	0.1965	0.1606	0.2559	0.3096	0.3240	0.3550	0.3774	0.4059	0.4865
EF_{BM}	0.0775											
EF_{CM} (montlhy)	0.1533	0.1364	0.1361	0.1370	0.1190	0.1667	0.1935	0.2007	0.2163	0.2274	0.2417	0.2820
EF_{CM} (annual)	**0.1842**											
--- 2008 ---	January	February	March	April	May	June	July	August	September	October	November	December
EF_{OM}	0.5727	0.6253	0.5794	0.4529	0.4579	0.5180	0.4369	0.4258	0.4102	0.4369	0.3343	0.4686
EF_{BM}	0.1458											
EF_{CM} (menthly)	0.3593	0.3856	0.3626	0.2994	0.3019	0.3319	0.2913	0.2858	0.2780	0.2913	0.2401	0.3072
EF_{CM} (annual)	**0.3112**											

The option chosen by the DNA to calculate the operating margin was option C) dispatch data analysis. Therefore, the emission factor has to be up-dated annually. Consequently, the emission factor can only be estimated *ex-ante* assuming a constant generation of the electricity by the project's plant.

Brazil, however, possesses a large share of hydroelectricity and during the years when an atypical short rainy season is observed the generation of electricity by the thermal power plants fuelled with fossil fuels rises. This was observed, for instance, in the year 2008 when the calculated emission factor was significantly higher when compared to those for 2006 and 2007 (Table 13).

Table 13 – Brazilian Interconnected System's Emission Factor for the year 2006, 2007 and 2008

	EF_{OM}	EF_{BM}	EF_{CM}
--- 2006 ---	0.3232	0.0814	0.2023
--- 2007 ---	0.2909	0.0775	0.1842
--- 2008 ---	0.4766	0.1458	0.3112
			0.2326

For this reason, to avoid significant discrepancies between emission reductions estimated in the PDD and the verified ones during the crediting period of the project activity, an average of the emission factor of the last three years – 0.2326 tCO_2e/MWh - was used to calculate the expected Emission Reductions by the proposed CDM Project Activity.

More information is available at the Brazilian DNA website (http://www.mct.gov.br/upd_blob/0024/24719.pdf).

Annex 4

MONITORING INFORMATION

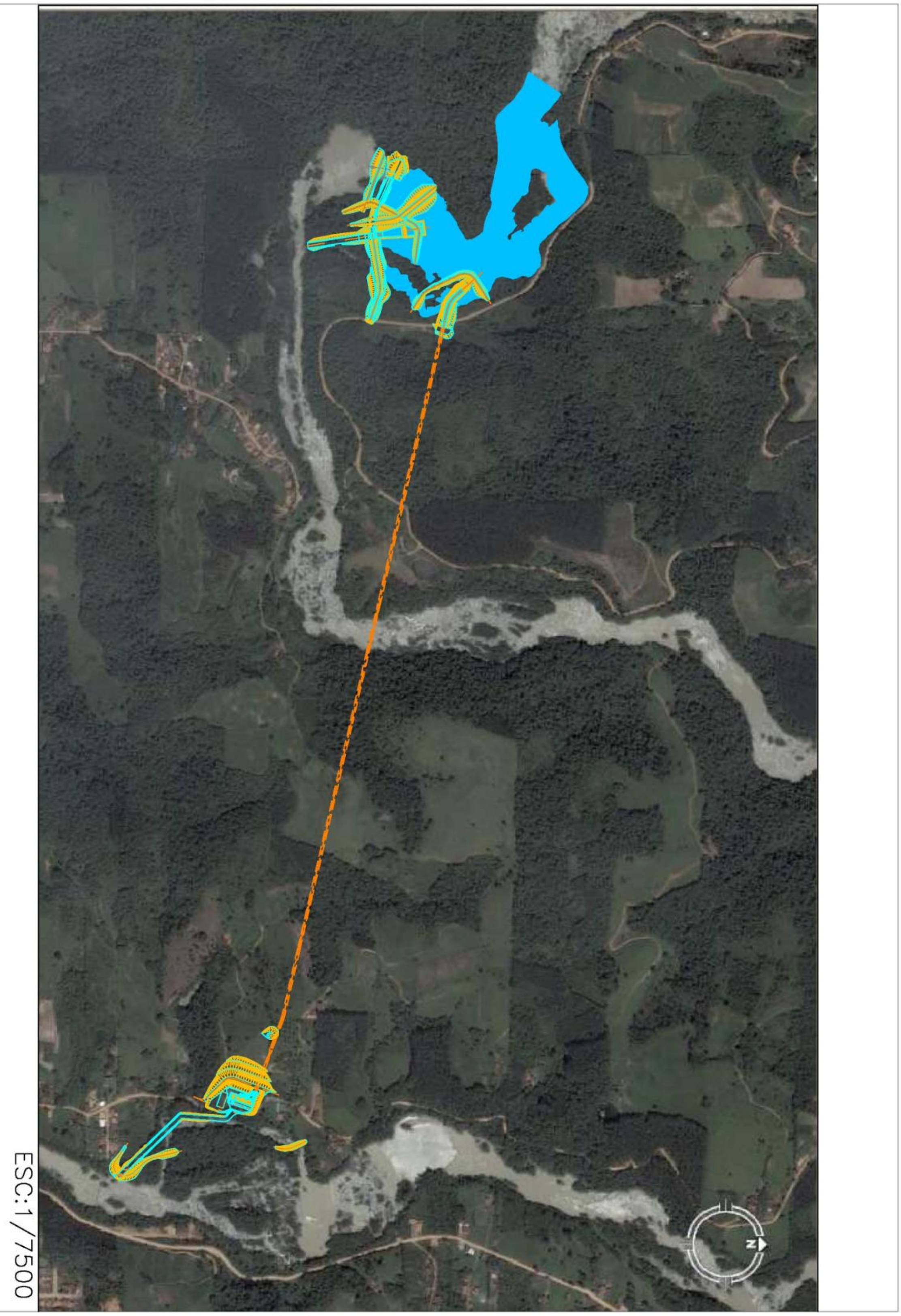
Methodology applicable to this project is the approved consolidated monitoring methodology ACM0002 – "Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources". More information can be seen at section B.7.2 – Description of the monitoring plan.

Annex 5

PROJECT DESIGN

(i) 1st Layout of Ibirama small hydropower plant project

(ii) 2nd Layout of Ibirama small hydropower plant project


ESC:1/7500
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