CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	▪ The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. ▪ As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	▪ The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

Faxinal dos Guedes Small Hydroelectric Power Plant (hereafter referred to as "FAXSHP")
Version 02
24 July 2007

A.2. Description of the small-scale project activity:

The FAXSHP project involves the implementation of a small hydroelectric power plant in the Chapecozinho river. The Chapecozinho river divides the Municipalities of Faxinal dos Guedes and Ouro Verde, in Santa Catarina State. The FAXSHP is sited in the south region of Brazil, where the largest coal reserves are located as well as most of thermo power plants using this fuel.

The main objective of the project is to help meet Brazil's rising demand for energy due to economic growth and to contribute to the environmental, social, and economic sustainability by increasing renewable energy's share of the total Brazilian electricity consumption.

FAXSHP, with a power loading of 4.0 MW, uses the hydro potential of the Chapecozinho river to supply electricity to the Brazilian South/Southeast/Midwest interconnected grid. Since 2003, the Brazilian Electricity Regulatory Agency (*Agência Nacional de Energia Elétrica*, ANEEL) issued commercial exploration licenses for at least tree thermoelectric plants connected to that grid (UTE Rio Claro at Mato Grosso State, UTE Santa Terezinha Paranacity at Paraná State, and UTE Viralcool at São Paulo State)[1] contributing to increase the greenhouse gas (GHG) emission factor of Brazil's energy system. The project activity will reduce these emissions by avoiding electricity generation through fossil fuel combustion, which would generate and release CO_2 in the atmosphere.

FAXSHP improves the supply of electricity with clean, renewable hydroelectric power while contributing to the regional/local economic development. The implementation of the project will result in an increase of energy supply in an opportune period, enabling the maintenance of the growing rate of Santa Catarina State of the order of 5% a year and reducing the risk of electricity deficit. The hydroelectric potential in commercial operation at the present time is insufficient to cover market demand, mainly in the summer season, when the tourism determines significant consumption growth, forcing the State to import more than 90% of its electricity demand from the South/Southeast/Midwest interconnected grid.
Small-scale hydropower run-of-river plants such as FAXSHP, provide local distributed generation, in contrast with the business as usual large hydropower and natural gas fired plants built in the last 5 years, and these small-scale projects provide site-specific benefits including:

- Increased reliability with shorter and less extensive outages;
- Lower reserve margin requirements;
- Improved power quality;
- Reduced lines losses;

[1] Source: *Boletim Energia*, number 97, 2003

- Reactive power control;
- Mitigation of transmission and distribution congestion; and
- Increased system capacity with reduced T&D investment.

A strong indication that FAXSHP contributes to the country's sustainable development goals is that the project is in accordance with the April 2002 law nº 10,438 of PROINFA (*Programa de Incentivo as Fontes Alternativas de Energia Elétrica*). PROINFA is a Brazilian federal program that gives incentive to alternative sources of electricity (wind, biomass, and a small scale hydropower plant). Among other factors, this initiative goal is to increase the renewable energy source share in the Brazilian electricity profile in order to contribute to a greater environmental sustainability through giving these renewable energy sources better economic advantages. The Brazilian government has committed a large monetary fund in order to develop this plan. Although FAXSHP is eligible for PROINFA, it had not applied to a Power Purchase Agreement (PPA) through PROINFA, and therefore, does not have access to the benefits of the program.

A.3. Project participants:

Name of the party involved (*) ((host) indicates a host Party)	**Private and/ or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the party involved wishes to be considered as project participant (yes/no)**
Brazil (host)	Hidrelétrica Rossi Ltda (private)	No
United Kingdom	MGM Carbon Portfolio, S.a.r.l (private)	No
(*) In accordance with CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a party involved may not have provided its approval. At the time of requesting registration, the approval by the party(ies) involved is required.		

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Brazil

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

State of Santa Catarina (South of Brazil)

A.4.1.3. City/Town/Community etc:

Faxinal dos Guedes and Ouro Verde

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

The FAXSHP is located in the kilometer 81 of Chapecozinho river, in the Municipalities of Faxinal dos Guedes and Ouro Verde, Santa Catarina State, Brazil (Figure 1). The coordinates are 26º 26’ South, 52º 14’West.

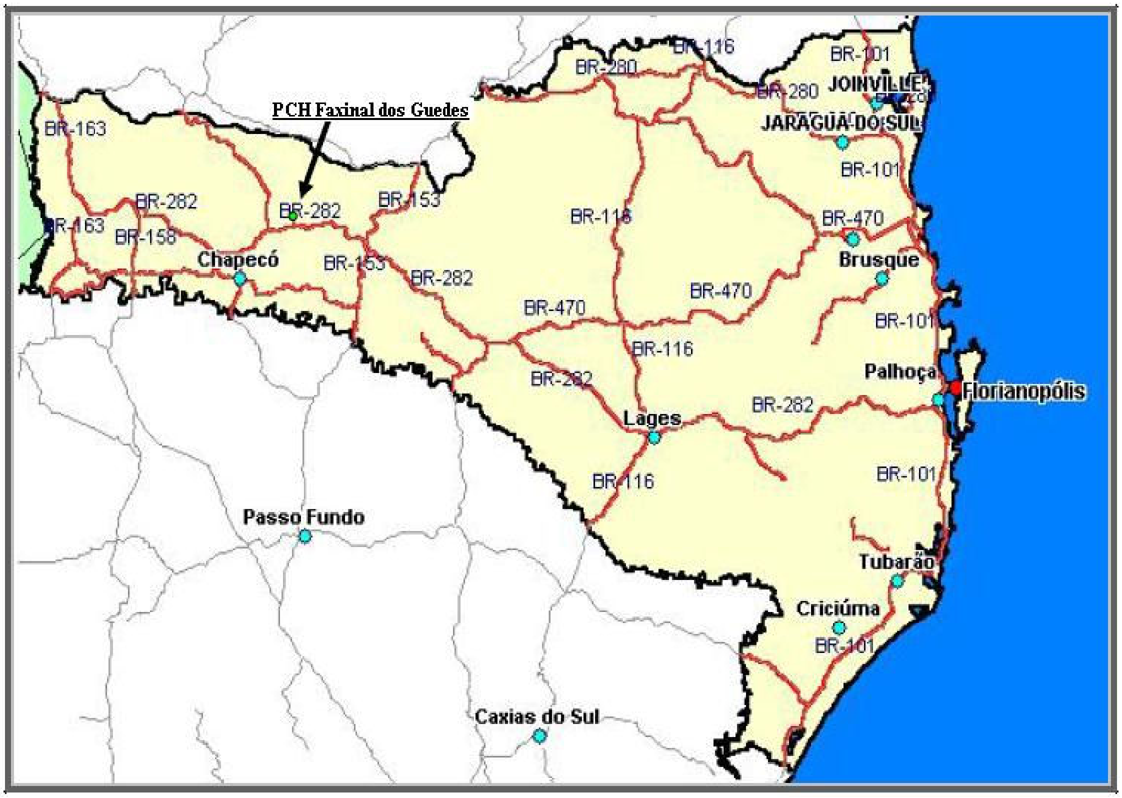

Figure 1: Map of Santa Catarina State showing the project location

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

According to the list of the small-scale CDM project activity categories contained in Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, the FAXSHP project corresponds to:

Type I: Renewable Energy Projects

Category D: Energy Generation for a System.

The FAXSHP, with a power loading of 4.0 MW, is introduced in the regional context as a low impact plant whose dam, designed to function as run of river, will flood 40 hectares in the normal operation conditions (elevation of 735.70 m) from which, (56%) corresponds to the natural water body of the

Chapecozinho River. The dam intends to store water in order to generate electricity for short periods of time.

Run-of-river schemes do not include significant water storage, and must therefore 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 flowing streams. According to Eletrobrás (1999), run-of-river projects are defined as "the projects where the river's dry season flow rate is the same or higher than the minimum required for the turbines". A low-level diversion dam raises the water level in the river sufficiently to enable an intake structure to be located on the side of the river. The intake consists of a trash screen and a submerged opening with an intake gate. Water from the intake is normally taken through a pipe (called a penstock) downhill to a power station constructed downstream of the intake and at as low a level as possible to gain the maximum head on the turbine.

The equipment and technology used in the FAXSHP project has been successfully applied to similar projects in Brazil and around the world. The equipment used in the project was developed and manufactured locally.

The Generation System comprises 02 identical generators, as specified bellow:

Nominal Output Power: 2500 kVA
Active Power: 2000 kW
Power Factor: 0.8
Nominal Voltage: 6600 V

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Table 2: Estimated emission reductions through the first 7-year crediting period

Year	Estimation of annual emission reductions in tonnes of CO_2e
2008 (March to December)	4,669
2009	5,603
2010	5,603
2011	5,603
2012	5,603
2013	5,603
2014	5,603
2015 (January and February)	0,934
Total estimated reductions (tonnes of CO_2e)	**39,219**
Total number of crediting years	**7**

Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**5,603**

A.4.4. Public funding of the small-scale project activity:

No public funding has been involved in financing this project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

In accordance with Appendix C of the Simplified M&P for the Small-Scale CDM Project Activities, the FAXSHP project is not a debundled component of a larger CDM project activity.

The project activity is an independent hydro power plant generating electricity and supplying to the grid, unrelated to any other CDM project activity in the region, existing or planned. The project proponent has not another registered small-scale CDM project activity, or an application to register another small-scale CDM project activity:

- in the same project category;
- registered within the previous 2 years; or
- whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

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

As mentioned above, according to the list of the small-scale CDM project activity categories contained in Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, the FAXSHP project corresponds to:

Type I: Renewable Energy Projects
Category D: Electricity Generation for a System

Thus, the methodology used in this project activity is AMS-I.D: Grid Connected Renewable Electricity Generation (Version 11).

B.2 Justification of the choice of the project category:

The FAXSHP qualifies under this project category since:

- The project activity is a hydroelectric power plant.
- The project activity supplies electricity to the Brazilian South/Southeast/Midwest interconnected grid.

The FAXSHP has a plate power capacity of 4.0 MW, which is lower than 15 MW, and thus, the project activity qualifies as a small-scale project activity and will remain under the limits of small-scale project activity types during every year of the crediting period.

B.3. Description of the project boundary:

The project boundary encompasses the physical, geographical site of the hydropower generation source, which is represented by the Chapecozinho river basin close to the power plant facility and the interconnected grid.

Brazil is a large country and is divided in five macro-geographical regions, North, Northeast, Midwest, Southeast, and South. The majority of the population is concentrated in regions Northeast, Southeast, and South. Thus, the energy generation and the transmission are concentrated in these three subsystems. The energy expansion has mainly been designed for specifics areas:

1. Northeast: the electricity for this region is basically supplied by the São Francisco River. With a total of 10.5 GW installed capacity.
2. South/Southeast/Midwest: the majority of the electricity generation and consumption in the country is concentrated in this region. This region also concentrated 70% of the GDP generation in Brazil.
3. North: 80% of the Northern region is supplied by diesel.

The boundaries of the subsystems are defined by the electricity transmission capacities of the 3 sub systems listed above. The transmission lines between the sub systems have a limited capacity and the exchange of electricity between those sub systems is difficult. The lack of sufficient transmission lines forces the use of most of the electricity generated in each own sub systems. Thus the South/Southeast/Midwest interconnected sub system of the Brazilian grid, where the project activity is located, is included in the spatial extent of the project boundary.

Part of the electricity consumed in the country is imported from other countries. Argentina, Paraguay, and Uruguay supply about 10% of the electricity consumed in Brazil[2]. Brazil also exported, sometimes, energies to these countries.

B.4. Description of baseline and its development:

According to the project category, and the corresponding methodology, the baseline is the energy produced by the renewable generating unit (MWh) multiplied by an emission coefficient (tCO_2e/MWh) calculated in a transparent and conservative manner as:

[2] Source: *Balanço Energético Nacional* - BEN, 2005

a) A combined margin (CM) emission factor, consisting of the combination of operating margin (OM) and build margin (BM) emission factors according to the procedures prescribed in the approved methodology ACM0002. Any of the four procedures to calculate the operating margin can be chosen, but the restrictions to use the Simple OM and the Average OM calculations must be considered, or
b) The weighted average emissions (in tCO_2e/MWh) of the current generation mix. The data of the year in which project generation occurs must be used.

For this project activity, the first option (option a) is selected. Thus, Version 06 of the approved methodology ACM0002 is used to determine the grid emission factor. Historically, most generation in Brazil has been hydroelectric. However, the less expensive hydroelectric resources are exhausted. Gas-fired power plants require much lower capital cost, thus representing low financial risk for investment. Brazil also has thermal power plants using coal, fuel oil, and diesel. Since fossil fired power plants have higher operating cost compared to hydro, these are likely to be displaced by generation from any hydro added to the system. Thus, it is reasonable to choose the first option for calculating the grid emission factor.

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (EF_{OM})

The operating margin refers to actual generation mix of the national grid.

Four different procedures are suggested by the methodology for determining the operating margin emission factor. These are:

(a) Simple Operating Margin
(b) Simple Adjusted Operating Margin
(c) Dispatch Data Analysis Operating Margin
(d) Average Operating Margin.

For this project activity, the Simple Adjusted Operating Margin method has been selected from the four options proposed in the methodology, since the low-cost/must-run resources constitute more than 50% of total grid generation and the dispatching information is not publicly available in Brazil.

According to the methodology, the simple adjusted operating margin emission factor can be calculated using one of the following data vintages:

- The full generation-weighted average for the most recent 3 years for which data are available at the time of PDD submission (*ex-ante*).
- The year in which project generation occurs, if the operating margin emission factor is updated based on data monitored (*ex-post*).

In this particular case, the *ex-ante* vintage is selected among the two options proposed by the methodology. As a consequence, the operating margin emission factor is calculated *ex-ante* and it is considered fixed along the first crediting period.

Step 2. Calculate the build margin emission factor (EF_{BM})

According to the methodology, the build margin emission factor can be calculated using one of the following options:

- Option 1: calculation *ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission.
- Option 2: for the first crediting period, *ex-post* annual update for the year in which actual project generation and associated emission reductions occur, and for the subsequent crediting periods, calculation *ex-ante* as described in Option 1.

In this particular case, Option 1 is selected among the two options proposed by the methodology. As a consequence, the build margin emission factor is calculated *ex-ante* and it is considered fixed along the first crediting period.

Step 3. Calculate the combined margin emission factor (EF_{grid})

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor.

In this case, for weighting these two factors, the default value of 50% will be considered for both, the operating margin and the build margin emission factors.

Baseline data sources

The national dispatch center supplied the raw dispatch data for the whole Brazilian interconnected grid.

The information on each generating source is not publicly available in Brazil. The National Power System Operator (*Operador Nacional do Sistema Elétrico*, ONS) argues that dispatching information is strategic to the power agents and therefore cannot be made available. On the other hand, ANEEL, the electricity agency, provides information on power capacity and other legal matters on the electricity sector, but no dispatch information can be got through this entity.

In that regard, project proponents looked for a plausible solution in order to be able to calculate the emission factor in Brazil in the most accurate way. Since real dispatch data is necessary after all, the ONS was contacted, in order to let participants know until which degree of detail information could be provided. After several months of talks, plants' daily dispatch information was made available for years 2003, 2004, and 2005.

The following table summarizes the key data necessary for the *ex-ante* determination of baseline emissions:

Table 3: Key data

Data	Source
Electricity generation of FAXSHP	Hidrelétrica Rossi Ltda
Electricity generation of the power plants serving the system	Operador Nacional do Sistema Elétrico, Centro Nacional de Operação do Sistema, Acompanhamento Diário da Operação do Sistema Interligado Nacional (daily reports)
Capacity additions to the system	Agência Nacional de Energia Elétrica, Banco de Informações da Geração
Fossil fuel conversion efficiencies	Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba. "Road testing baselines for greenhouse gas mitigation projects in the electric power sector." OECD and IEA information paper, October 2002. Where plant-specific efficiency data are not available, the following values are used: ▪ Combined cycle gas turbine power plants: 50% ▪ Open cycle gas turbine power plants: 32%, ▪ Sub-critical coal power plants: 33% ▪ Oil based power plant sub-critical oil boiler: 33%. Source: CDM-EB-2005.11.29-DOEs request for guidance on average plant efficiencies. Decision of the CDM EB responding to DNV "Request for guidance: Application of AM0015 (and AMS-I.D) in Brazil, dated 7 October 2005.
Emission factors and oxidation factors of fuels	IPCC Guidelines for National GHG Inventories

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 small-scale CDM project activity:

In accordance with Attachment A of Appendix B of the Simplified M&P for the Small-Scale CDM Project Activities, a barrier analysis could be carried out in order to demonstrate project additionally, as described bellow (30 September 2005 edition):

"*Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:*

(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;

(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;

(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;

(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources,

organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher."

The project activity has been initiated in December 19th, 2002, as stated in the Resolution nº 737 of December 18th, 2002, issued by ANEEL, which authorizes to Hidrelétrica Rossi Ltda to be established as an Independent Power Producer[3]. However, the FAXSHP started supplying electricity to the grid on February 2007 [4]. Nevertheless, the achievement of such target required efforts to remove several barriers.

To justify the additionality for this project, some previous internal analysis of the above alternatives were done and it was decided that this analysis will be focused on the alternative *c*) *Barrier due to prevailing practice:*

Prevailing Business Practice

The prevailing business practice in Brazil as far as obtaining financing and financial guarantees to project is a barrier to investment in renewable energy projects in the country. Given the various programs and incentives, which were considered along the last years, but never successfully implemented, it is possible to notice the difficulty and barriers to implement small hydro projects in the country. An indication of this barrier is exemplified by the Program called PCH-COM, structured by the end of 2000 and beginning of 2001. In 2001, Eletrobrás, in partnership with BNDES, launched the PCH-COM program, which had as its main goal to support and encourage the construction of small hydropower plants. This program consisted in the financing of the project by BNDES and the commercialization of the power by Eletrobrás. The operation of the program consisted on the analysis of the project by both BNDES and Eletrobrás. In case the project was approved, there would have been two contracts to be signed: the financing one with BNDES and the Power Purchase Agreement (PPA) with Eletrobrás. The program was not successful because of the guarantees needed and the clauses of the contracts (i.e., the project was not considered as a project finance basis and the lender demanded for direct guarantees from the developer, other than the project itself). After that, the government created, in 2002, the PROINFA program, which foresees raising the share of renewable energy power generation by adding 3,300 MW installed capacity of small-hydro power plants, wind-power, and biomass, offering long-term contracts with special conditions, lower transmission costs, and smaller interest rates from the local development banks. In 2005, the BNDES presented the last final version of its financing incentive line to PROINFA, which is different from the one first considered for the program and that was not considered sufficiently attractive by potential entrepreneurs.

Aware of the difficulties mentioned above, FAXSHP decided not apply to PROINFA, and therefore, does not have access to the benefits of the program.

Another important aspect of prevailing business practice is related to the small participation of small hydro power plants in the Brazilian electric portfolio, which is commented in sequence:

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[3] See the resolution in the following link:

http://www.cndpch.com.br/zpublisher/paginas/legisredirect.asp?link=http://www.aneel.gov.br/cedoc/res2002737.pdf

[4] Aneel resolution, number 477, issued on 23 February 2007

Due to all what was exposed above, and in spite of all government incentives, an analysis based on data available at July 13th, 2007, shows that [5]:

a) there are 190 approved small hydropower plant projects in Brazil between 1998 and 2005, which have not started construction yet.

b) Small hydropower plants in operation, correspond to less than 2% of the total electric power generated in the country, and also correspond to less than 2% of the total electric power generated in the Santa Catarina State (SC), where the FAXSHP is located

The recent trend does not anticipate changes from what has been observed in the last decade. In an energy auction, which took place on December 16th, 2005, in Rio de Janeiro, 20 concessions for new power plants were granted, of which only two are for small hydropower plants (28 MW). From the total of 3,286 MW sold, 2,247 MW (68%) will come from thermal power plants, from which 1,391 MW come from natural gas fired thermal power plants, i.e., 42% of the total sold [6].

These numbers show that:

1) Common practice in Brazil has been the construction of large-scale hydroelectric plants and, more recently, of natural gas based thermal plants

2) Incentives for the construction of thermal power plants have been more effective than those for small hydropower plants.

The recent nationalization of the natural gas industry by the Bolivian government which occurred at the begin of 2007 might change this situation, but perspectives are not clear so far.

In summary, FAXSHP cannot be considered common practice and therefore does not fit in the business as usual type scenario.

Conclusions

As defined by ANEEL[7], small hydro power plants are power plants with installed capacity greater than 1 MW and up to 30 MW, and with reservoir area lower than 3 km². Generally, it consists of a run-of-the-river hydro plant, which has a minimum environmental impact. This is not the business-as-usual scenario in a country where large hydro and thermal fossil fuel projects are preferable. CDM has made it possible for some investors to set up small hydro plants and sell electricity to the grid and this fact has motivated the implementation of Faxinal dos Guedes plant. With the financial benefit derived from the CERs, it is anticipated that other project developers would benefit from this new source of revenues and would then decide to develop such projects.
The registration of the proposed project activity will help Faxinal dos Guedes to improve its economic performance and may have a strong impact in paving the way for similar projects to be implemented in Brazil.

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[5] Source: http://www.aneel.gov.br/area.cfm?idArea=15 (Capacidade Geração Brasil and Resumo Estadual)
[6] Source: Rosa, Luis Pinguelli. Brazilian. Newspaper "Folha de São Paulo", December 28, 2005.
[7] Resolution n. 394, December 4th, 1998.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the project category and the corresponding methodology, project emissions are zero and leakage is to be considered only when the energy generating equipment is transferred from another activity. This is not the case of FAXSHP. The energy conversion equipment for the project was manufactured new for specific site conditions. Therefore, there is no leakage associated to the project activity.

Then, emission reductions obtained during the year *y* (ER_y, in tCO_2e/year) are equal to baseline emissions calculated by multiplying the combined margin emission factor ($EF_{grid\ y}$, in tCO_2e/MWh) by the electricity generated by the proposed project activity during the year *y* (EG_y, in MWh), as follows:

$$ER_y = EG_y \times EF_{grid\ y} \qquad (1)$$

The combined margin (CM) emission factor consists of the combination of operating margin (OM) and build margin (BM) emission factors according to the procedures prescribed in the approved methodology ACM0002.

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (EF_{OM})

As mentioned above, in order to determine the combined margin emission factor, the Simple Adjusted Operating Margin method has been selected from the four options proposed in the methodology, since the low-cost/must-run resources constitute more than 50% of total grid generation and the dispatching information is not publicly available in Brazil.

The simple adjusted operating margin emission factor (tCO_2e/MWh) is a variation of the simple operating margin emission factor[8], where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*), as follows:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j} \times COEF_i}{\sum_j GEN_j} + \lambda \frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} \qquad (2)$$

where

λ	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
$F_{i,j}$ / $F_{i,k}$	Amount of fuel *i* consumed by relevant power sources *j*/*k* (in mass or volume unit)
GEN_j/GEN_k	Electricity delivered to the grid by power sources *j*/*k* (MWh)
$COEF_i$	CO_2 emission coefficient for fuel *i*. (tCO_2e/mass or volume unit)

The CO_2 emission coefficient $COEF_i$ is obtained as follows:

$$COEF_i = NCV_i \times CEF_i \times OXID_i \qquad (3)$$

where

NCV_i	Net calorific value of fuel *i* (energy unit/mass or volume unit)
CEF_i	CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/energy unit)
$OXID_i$	Oxidation factor of fuel *i* (%)

On the other hand, the lambda factor (λ) is the determined as:

$$\lambda = \frac{number\ of\ hours\ per\ year\ for\ which\ low-\cos t/must-run\ sources\ are\ on\ m\arg in}{8{,}760\ hours\ per\ year} \qquad (4)$$

According to the methodology, the number of hours during low-cost/must-run sources are on the margin are obtained through the following procedure (see Figure 5 below):

[8] The simple operating margin emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants.

Step i) Plot a Load Duration Curve

Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8,760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources

Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources.

Step iii) Fill Load Duration Curve

Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources.

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin"

First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8,760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and lambda is equal to zero. Lambda is the calculated number of hours divided by 8,760.

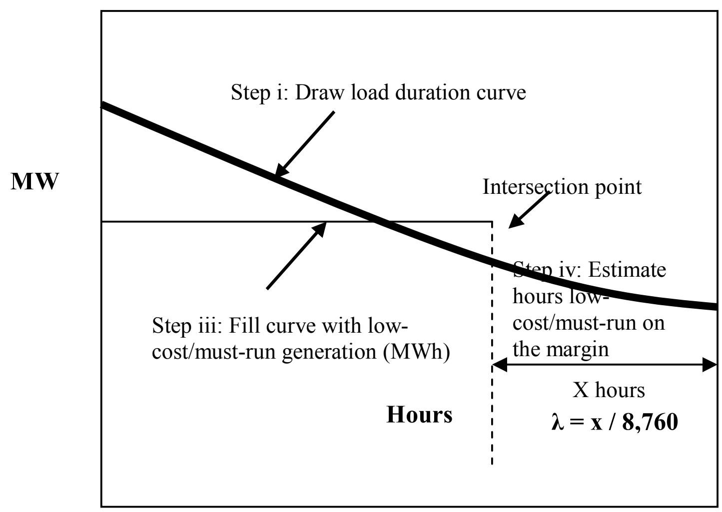


Figure 5: Illustration of lambda calculation for simple adjusted operating margin emission factor

Step 2. Calculate the build margin emission factor (*EF_{BM}*)

The build margin emission factor of each crediting period is calculated as follows:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} \times COEF_i}{\sum_{m} GEN_m} \qquad (5)$$

where $F_{i,m}$, $COEF_i$ and GEN_m are analogous to the variables described above for the operating margin emission factor determination.

The sample group *m* consists of either:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

According to the methodology, from these two options, the sample group that comprises the larger annual generation should be used.

Step 3. Calculate the combined margin emission factor (*EF_{grid}*)

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. For weighting these two factors applying the default value of 50% for both, the operating margin and the build margin emission factors, the combined margin emission factor is obtained as follows:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} \qquad (6)$$

B.6.2. Data and parameters that are available at validation:

Table 5: Data available at validation

Data / Parameter:	GEN_j/GEN_k
Data unit:	MWh
Description:	Electricity delivered to the grid by power sources j/k
Source of data used:	ONS, the national dispatch center (daily reports)
Value applied:	See Annex 3 below
Justification of the choice of data or description of measurement methods and procedures actually applied :	The national dispatch center supplies the raw dispatch data for the whole Brazilian interconnected grid. This data source is relevant for the calculation of the baseline.
Any comment:	These data are available in an excel spreadsheet

Data / Parameter:	Power Plants (Built Margin)
Data unit:	N/A
Description:	New Electric Power Plants added to the Electric System
Source of data used:	National Agency of Electric Power (Aneel) - Agência Nacional de Energia Elétrica. (http://www.aneel.gov.br/).
Value applied:	Data collected in December 2005
Justification of the choice of data or description of measurement methods and procedures actually applied :	Aneel is a Federal Agency which is in charge to regulate and supervise the Electric Generation, Transmission, Distribution and the commercialization of Electric Energy
Any comment:	These data are available in an excel spreadsheet

Data / Parameter:	EFy
Data unit:	tCO_2/MWh
Description:	Emission factor for the Brazilian South/Southeast/Midwest interconnected grid
Source of data used:	Data for EFy calculation were provided by ONS (the national dispatch center)
Value applied:	0.2611

Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are from an official source, and are made public available. The calculation for this combined margin is based on the approved methodology ACM0002, version 6.
Any comment:	These data are available in an excel spreadsheet

B.6.3 Ex-ante calculation of emission reductions:

As mentioned above, since project emissions and leakage emissions are zero, emission reductions are the same as baseline emissions, as follows:

$$ER = EG \times EF_{grid}$$

The FAXSHP is expected to generate around 21,725MWh per year, as shown in the following table:

Table 6: Expected annual electricity generation

Plant capacity **(A)**	4.0 MW
Annual hours **(B)**	8,760 hr/year
Capacity factor **(C)**	61.125%
Electricity generation (A) x (B) x (C)	**21,462 MWh/year**

As mentioned above, the emission factor of the grid is determined using the Version 06 of the methodology ACM0002 as a combined margin emission factor, consisting of the combination of the operating margin and the build margin factors.

As is shown in Annex 3 below, the operating margin emission factor results to be 0.4349 tCO_2/MWh and the build margin emission factor 0.0872 tCO_2/MWh. Thus, the resulting grid emission factor is:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} = \frac{(0.4349 + 0.0872)}{2}$$ tCO_2/MWh = **0.2611 tCO_2/MWh**

Thus, the annual emission reduction results to be:

ER = 21,725 MWh/year x 0.2611 tCO_2/MWh = **5, 603 tCO_2/year**

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

Table 7: *Ex-ante* estimation of emission reductions during the first 7-year crediting period

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of Leakage (tCO_2e)	Estimation of Overall reductions (tCO_2e)
2008 (March to December)	0	4,669	0	4,669
2009	0	5,603	0	5,603
2010	0	5,603	0	5,603
2011	0	5,603	0	5,603
2012	0	5,603	0	5,603
2013	0	5,603	0	5,603
2014	0	5,603	0	5,603
2015 (January and February)	0	0,934	0	0,934
Total (tonnes of tCO_2e)	**0**	**39,219**	**0**	**39,219**

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

B.7.1 Data and parameters monitored:

Table 8: Data to be monitored

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity generated by the renewable technology in the year y
Source of data to be used:	Hidrelétrica Rossi Ltda
Value of data	21, 462
Description of measurement methods and procedures to be applied:	Electricity delivered to the grid will be monitored by the project (seller) and by the electricity buyer through electricity meter connected to the grid and through sales receipt. This data will be measured each 15 minutes and recorded monthly.

QA/QC procedures to be applied:	The uncertainty level of the data is low, and the equipment will be regularly calibrated.
Any comment:	This data will be used to calculate the emission reductions obtained through the project activity. Data will be archived electronically until two years after finishing the crediting period.

B.7.2 Description of the monitoring plan:

According to Type I, Category D of small-scale project activity categories contained in appendix B of the Simplified M&P for CDM Small-Scale Project Activity, monitoring shall consist of metering the electricity generated by the renewable technology.

FAXSHP assigned a qualified person to compile the necessary data according to the approved methodology to accurately calculate emission reductions. The data will be compiled in a manner amenable to third party audit and deliverable to the DOE for validation and certification purposes.

For this project, the methodology is applied through a spreadsheet model. The responsible for project monitoring must complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved by the project.

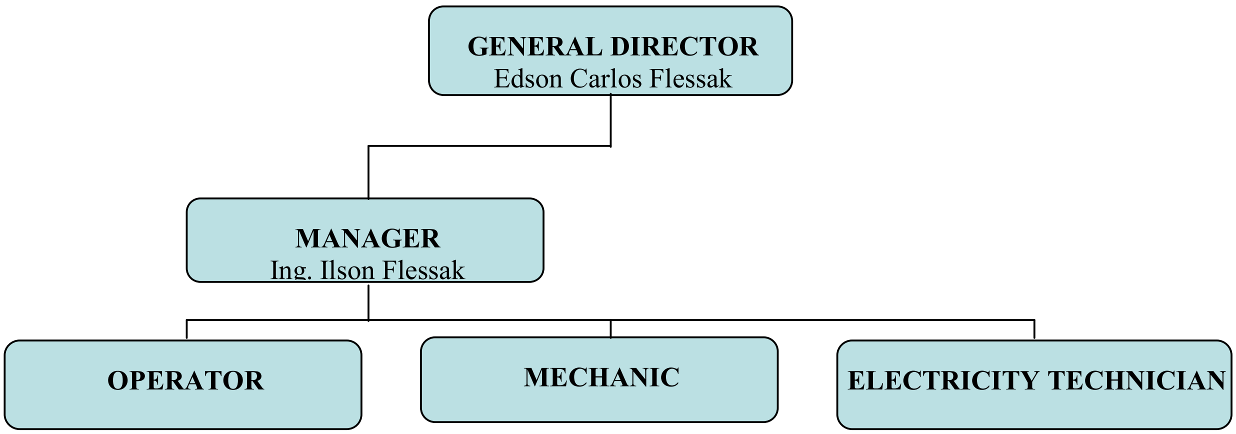
FAXSHP has a supervision system, manufactured by SEMI Engenharia. The electrical parameters are measured and sent to the central supervision equipment. The mentioned central supervision equipment has the ability to generate reports, and historical data.

The generated energy is being transmitted to a substation belonging to the power utility CELESC.
The monitoring equipment (model Saga 1000) was installed by the seller. The equipment will be calibrated each three years. This equipment is on line to the CCEE (Electrical Energy Commercialization Chamber), who will be responsible for the accounting of the supplied energy. The monitoring of these measurements is performed under the responsibility of CELESC. It records the supplied energy in MWh through measurements made every fifteen minutes. The measurements are archived electronically.

All the monitored data will be kept in archive for the crediting period and two more years.

During the period that precedes the first crediting period, an internal written procedure will be prepared, covering the aspects to warrant the quality and the reliability of the monitoring process, including essentially the following items:
-Procedures for training, periodical update and eventual substitution of operators and other personnel involved in the monitoring process;
-Procedures for quality assurance and calibration of measuring equipment;
-Procedures for archiving and back-up of monitored data;
-Procedures for recording activities related to above mentioned subjects;

The operational and management structure to be implemented is the following:



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

Date of completion: 01/12/2005 (revised on 09/03/2007)

Name of the responsible person/entity:

- Osvaldo Stella Martins PhD

- João M. Franco and Marisa Zaragozi, MGM International SRL
  Av. Luis Carlos Berrini, 1297 cj.121
  CEP 04571-010, São Paulo - Brazil
  Tel. (55 11) 5102 3844

Osvaldo Stella Martins and João M. Franco and Marisa Zaragozi are not project participants.

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:

The project activity has been initiated in December 19th, 2002, as stated in the Resolution nº 737 of December 18th, 2002, issued by ANEEL, which authorizes to Hidrelétrica Rossi Ltda to be established as an Independent Power Producer. However, the FAXSHP started supplying electricity to the grid on February 2007.

Thus, the starting date of the project activity can be considered as: 24/02/2007

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

25 years

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:

01/03/2008

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

As for the environmental permits, the proponent of any project that involves the construction, installation, expansion, and operation of any polluting or potentially polluting activity or any activity capable of causing environmental degradation is required to secure a series of permits from the respective state environmental agency.. Three types of permits are required. The first is the preliminary permit (*Licença Ambiental Prévia*, LAP) issued during the planning phase of the project and which contains basic requirements to be complied with during the construction, and operating stages. The second is the construction permit (*Licença Ambiental de Instalação*, LAI) and, the final one is the operating permit (*Licença Ambiental de Operação*, LAO).

The process starts with a previous analysis (preliminary studies) by the local environmental department. After that, if the project was considered environmentally feasible, the sponsors have to prepare the Preliminary Environmental Assessment, which is basically composed by the following information:

- Reasons for project implementation;

- Project description, including information regarding the reservoir and the utility;
- Preliminary Environmental Diagnosis, mentioning main biotic, and anthropic aspects;
- Preliminary estimative of project impacts; and
- Possible mitigation measures and environmental programs.

The result of a successful submission of those assessments is the preliminary license, which reflects the environmental local agency positive understanding about the environmental project concepts.

To get the construction license, it will be necessary to present either: (a) additional information into previous assessment; or (b) a new more detailed simplified assessment; or (c) the PBA, according environmental local agency decision at the preliminary license issued. The operation license will be obtained as result of pre-operational tests during the construction phase, carried out to verify if all exigencies made by environmental local agency were satisfied.

All documents related to operational and environmental licensing are public and can be obtained at the state environmental agency (FATMA-SC).

Given the project is below the environmental legislation criteria of a small-scale size up to 15 MW, it has a fast-track environmental assessment process due to its reduced impact.

The power plant has all the licenses emitted by the environmental agency of the State of Santa Catarina (*Fundação do Meio Ambiente*, FATMA):

(LAP): prior environmental licensing, and installation licensing (number 426/2003), issued on october 20, 2003. This licensing was renovated (LAI number 190/2005, issued on august 17, 2005)

(LAO): Operation environmental license , number 512/2006, issued on October 31, 2006

The implementation of the environmental requests contained in the LAI, were performed as requested. These requests remain valid after the LAO issuance, as part of the Operation Licensing process.

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 proposed project is a run-of-river hydropower plant, which involves no dam construction. Therefore, the environmental impact is very small compared to other types of power generations alternatives.

SECTION E. Stakeholders' comments

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

The Resolution number 1, issued by Brazilian DNA, established that the consultation must be performed by the project sponsor at least with the following entities:

- Municipality and Alderman Chamber
- State and Municipal Environmental Agencies

- Brazilian Forum of NGOs
- Community Associations
- Public Ministry

The stakeholders who were invited to participate in this process are the following:

- Municipality (Faxinal dos Guedes)
- Municipality (Ouro Verde)
- Alderman Chamber (Faxinal dos Guedes)
- Alderman Chamber (Ouro verde)
- State Environmental Agency:
  FATMA – Fundação Amparo Tecnologia Meio Ambiente
- Municipal Environmental Agency (Faxinal dos Guedes)
- Municipal Environmental Agency (Ouro Verde)
- Brazilian Forum of NGOs – Forum Brasileiro de ONGs e Movimentos Sociais para o Meio Ambiente e Desenvolvimento
- Local school (EEB Prof. Salustiano Antonio Cabrera)
- Community Association (Faxinal dos Guedes)
- Community Association (Ouro Verde))
- Aneel (electrical regulatory agency
- Public Ministry (Faxinal dos Guedes and Ouro Verde

The most of invitation letters were sent to the stakeholders listed above during November 2006. The copies of the letters and the acknowledgement of receipt (called AR in Brazil) will be shown to the DOE during the validation process.

With the purpose to facilitate the comments of the invited persons, the following questionnaire was sent to the stakeholders:

1. Do you believe that the socio-economic situation of the region will improve due to the implementation of the project?
2. Is the implementation of project able to improve the environmental situation in the region?
3. How does the development of the project affect you (positively or negatively) or your environment?
4. Would you recommend private companies or authorities to develop projects of this nature?
5. Do you think the project will contribute to the Brazilian Sustainable Development?
6. Any additional comments you would like to make.

The following documents were publicly available at a website available to all potential stakeholders[9]:

- Presentation on the Faxinal dos Guedes Project
- Executive Summary of Faxinal dos Guedes Project
- Project Design Document (PDD)
- Anexo III (regarding Resolution Nº 1 of the CIMGC)

[9] http://www.flessak.com.br

- General Concepts on Greenhouse Effect and the Kyoto Protocol

This webpage was initiated on November 16th, 2006, and is indicated in the letter inviting stakeholder comments

E.2. Summary of the comments received:

Researches made with the local community demonstrated no opposition to the construction of the plant. This information was considerate in the decision to continue with the project, mainly by the fact that the displacement of households generates expectation of unquietness as well as voluptuous investment demands, making plants with low installation capacity not feasible.

The entities and persons who commented on the project were:

- Municipality of Faxinal dos Guedes: Mr.Claudemir Basquera (assessor)
- Municipal Environmental Agency (Mr. Adriano F. Conti)
- Leo Club of Ouro Verde Municipality (Mrs. Luciana Serafim Mees)

All the presented comments were positive, emphasizing the project will be one more source of employment and resources for the municipality, besides supplying electric energy for the region.

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

Since all stakeholders consulted so far, support the project, no modifications to project design were necessary.

However, despite the acceptance of the project, we emphasize that the environmental aspects will be carefully observed with the objective to manage any eventual environmental impact.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Table 9: Non-Annex I project participant

Organization:	Hidrelétrica Rossi Ltda.
Street/P.O.Box:	Anta Gorda Farm, Lajeado Carreteiro
Building:	
City:	Ouro Verde
State/Region:	Santa Catarina
Postfix/ZIP:	89834-000
Country:	Brazil
Telephone:	55 46 35201060
FAX:	
E-Mail:	edson@flessak.com.br
URL:	
Represented by:	
Title:	Director
Salutation:	
Last Name:	Flessak
Middle Name:	
First Name:	Edson
Department:	
Mobile:	
Direct FAX:	
Direct tel:	55 46 35201060
Personal E-Mail:	edson@flessak.com.br

Organization:	MGM Carbon Portfolio, S.a.r.l
Street/P.O.Box:	121, Avenue de la Faïencerie, L-15511
Building:	
City:	
State/Region:	Luxemburg
Postfix/ZIP:	
Country:	
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	Ivana Cepon
Title:	Business Developer Manager
Salutation:	Mrs.
Last Name:	Cepon
Middle Name:	
First Name:	Ivana
Department:	
Mobile:	54.9.11.5509.1592
Direct FAX:	+1.305.675.0968
Direct tel:	+ 54.11.5219.1230
Personal E-Mail:	icepon@mgminter.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been involved in financing this project activity.

Annex 3

BASELINE INFORMATION

Calculation of the grid emission factor

ACM0002 indicates that the emission factor of the grid is determined by the following three steps:

1. Calculate the operating margin emission factor
2. Calculate the build margin emission factor
3. Calculate the combined margin emission factor by working out the weighted average of the operating margin emission factor and the build margin emission factor

Step 1. Calculate the operating margin emission factor (*EF_{OM}*)

The simple adjusted operating margin emission factor (tCO_2e/MWh) is a variation of the simple operating margin emission factor[10], where the power sources (including imports) are separated in low-cost/must-run power sources (*k*) and other power sources (*j*), as follows:

$$EF_{OM} = (1-\lambda)\frac{\sum_{i,j} F_{i,j} \times COEF_i}{\sum_j GEN_j} + \lambda \frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} \qquad (2)$$

where

λ	Lambda factor: fraction of time during low-cost/must-run sources are on the margin
$F_{i,j}/F_{i,k}$	Amount of fuel *i* consumed by relevant power sources *j*/*k* (in mass or volume unit)
GEN_j/GEN_k	Electricity delivered to the grid by power sources *j*/*k* (MWh)
$COEF_i$	CO_2 emission coefficient for fuel *i*. (tCO_2e/mass or volume unit)

In the case of the South/Southeast/Midwest interconnected sub system of the Brazilian grid, all the low-cost/must-run plants produce zero net emissions, and thus:

$$\frac{\sum_{i,k} F_{i,k} \times COEF_i}{\sum_k GEN_k} = 0$$

The CO_2 emission coefficient $COEF_i$ is obtained as follows:

[10] The simple operating margin emission factor is calculated as the generation-weighted average emissions per electricity unit (tCO_2e/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants.

$$COEF_i = NCV_i \times CEF_i \times OXID_i \qquad (3)$$

where

NCV_i	Net calorific value of fuel *i* (energy unit/mass or volume unit)
CEF_i	CO_2 emission factor per unit of energy of the fuel *i* (tCO_2e/energy unit)
$OXID_i$	Oxidation factor of fuel *i* (%)

On the other hand, the lambda factor (λ) is the determined as:

$$\lambda = \frac{number\ of\ hours\ per\ year\ for\ which\ low-\cos t/must-run\ sources\ are\ on\ m\arg in}{8{,}760\ hours\ per\ year} \qquad (4)$$

The dispatch data provided by the ONS[11] is treated as to allow calculation of the operating margin emission factor for the most three recent years with available information, which are 2003, 2004, and 2005.

The electricity generation and imports corresponding to each year are provided in the table below.

Table 10: Electricity generation and imports (MWh)

Year	Electricity load	Electricity generation by low-cost/must-run power sources	Imports
2003	288,933,290	274,670,644	459,586
2004	302,906,198	284,748,295	1,468,275
2005	314,533,592	296,690,687	3,535,252

[11] *Operador Nacional do Sistema Elétrico*, *Centro Nacional de Operação do Sistema*, *Acompanhamento Diário da Operação do Sistema Interligado Nacional* (daily reports from January 1st, 2003 to December 31st, 2005)

The lambda factors are calculated as explained above in Section B.6.1. The table below presents the values obtained:

Table 11: Lambda factors

Year	λ
2003	0.5312
2004	0.5055
2005	0.5130

Using the appropriate information for fossil fuel conversion efficiencies and CO_2 emission coefficients, the operation margin emission factors for each year is calculated and the mean average among the three years results to be 0.4349 tCO_2/MWh.

Step 2. Calculate the build margin emission factor (*EF_{BM}*)

The build margin emission factor of each crediting period is calculated as follows:

$$EF_{BM} = \frac{\sum_{i,m} F_{i,m} \times COEF_i}{\sum_{m} GEN_m} \quad (5)$$

where $F_{i,m}$, $COEF_i$ and GEN_m are analogous to the variables described above for the operating margin emission factor determination.

The sample group *m* consists of either:

- The five power plants that have been built most recently, or
- The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

According to the methodology, from these two options, the sample group that comprises the larger annual generation should be used.

Using the information related to the new electric power plants added to the system provided by ANEEL[12], data provided by the ONS corresponding to year 2005, and the appropriate information for fossil fuel conversion efficiencies and CO_2 emission coefficients, the build margin emission factor is calculated and results to be 0.0872 tCO_2/MWh.

[12] *Agência Nacional de Energia Elétrica*, *Banco de Informações da Geração*

Step 3. Calculate the combined margin emission factor (*EF_{grid}*)

The baseline emission factor is calculated as the weighted average of operating margin emission factor and the build margin emission factor. For weighting these two factors applying the default value of 50% for both, the operating margin and the build margin emission factors, the combined margin emission factor is obtained as follows:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} \qquad (6)$$

Thus, the resulting grid emission factor is:

$$EF_{grid} = \frac{(EF_{OM} + EF_{BM})}{2} = \frac{(0.4349 + 0.0872)}{2}$$ tCO_2/MWh = **0.2611 tCO_2/MWh**

The data and the spreadsheet with the calculation of the emission factor will be shown to the DOE during the validation process.

Annex 4

MONITORING INFORMATION

According to the Type I, Category D of CDM small-scale project activity categories contained in Appendix B of the simplified M&P for CDM small-scale project activities, and according to the AMS ID, version 10, the monitoring shall consist of metering the electricity generated by the renewable technology (hydroelectricity).

The methodology ACM 0002 describes the procedure and equations for calculating emission reduction from monitored data. For this specific project, the methodology is applied through a spreadsheet model. The staff responsible for project monitoring must complete the electronic worksheets on a monthly basis. The spreadsheet automatically provides annual totals in terms of GHG reductions achieved by the project. The model contains a series of worksheets with different functions:

- Data entry sheets (*Electricity Generation* and *Grid Emission Factor*)
- Result sheet (*Emission Reduction*)

There are cells where the user is allowed to enter data. All other cells contain computed values that cannot be modified by the staff.

A color-coded key is used to facilitate data input. The key for the code is as follows***:***

- ***Input Fields:*** Pale yellow fields indicate cells where project operators are required to supply data input, as is needed to run the model;
- ***Result Fields:*** Green fields display result lines as calculated by the model.

All electronic data will be backed up on a daily basis, and two electronic copies of each document will be kept in different locations (the project site and the Head Office). These data will be archived for two years following the end of the crediting period.

Annex 5

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