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:

ESTRE Pedreira Landfill Gás Project (EPLGP)
Version 5
30/03/2007

A.2. Description of the project activity:

The EPLGP aim is to capture and flare the landfill gas produced at CDR Pedreira, landfill owned by CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. and located in São Paulo, to avoid emissions of methane to the atmosphere.

CDR Pedreira landfill started operation in October 2001 and was designed to be a center of excellence in the treatment and waste disposal in São Paulo. A mining site was used to install the landfill. The landfill's total area is 562 052 m², of which 412 437 m² are still available. An additional area of 290 400 m² is used as a legal green belt reserve. The CDR Pedreira landfill has the capacity to receive 16.7 million tones of waste. The landfill counts with 3 main clients, which dispose approximately 360 ton/day in the landfill. CDR Pedreira landfill fulfills all technical and environmental requirements applicable for both household and industrial waste treatment.

CDR Pedreira's landfill current practice is to collect and burn the gas only through a passive system, with no systematic and monitored flare. Methane is emitted naturally to the atmosphere through the existing wells, and part of the gas is burned as a consequence of safety and odor concerns. Therefore, an extra-incentive is needed for CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. to make additional investments in order to enhance its landfill gas collection rate and install appropriate facilities to flare the methane produced at the site. The project involves the development of a collection pipeline network and a flaring system. The collection system will be built using the existing wells, and new wells can be built when necessary. The wells will be covered and connected to a main pipeline to transport the landfill gas to the flare. A blower will be installed in order to increase the amount of landfill gas collected.

Respecting current environmental legislation and good practices for landfill projects, construction and operation, CDR Pedreira landfill is licensed from both the State Secretary of Environment (Secretaria do Estado do Meio Ambiente – SMA) and the state of São Paulo environmental agency (Companhia de Tecnologia de Saneamento Ambiental – CETESB) for the treatment and disposal of household and industrial waste. CDR Pedreira landfill received ISO 14001 Certificate in 2004 (Figure 1).

EPLGP will have a significant impact on sustainable development. First, while reducing methane emissions that would enhance climate change, it will also minimize the risk that any explosion occurs at the site – although CDR Pedreira's engineering and design specifically aims at avoiding this type of accidents. Second, given the fact that initiatives of this type are relatively new in Brazil, a significant technology transfer will be needed for the project's implementation and operation. Third, specialized operators will be needed for project operation, which means a positive impact on employment and capacity-building. The aforementioned elements concur in making the project extremely vital in the context of sustainable development.

DNV

OCA- 0003

DET NORSKE VERITAS

CERTIFICADO DE SISTEMA DE GESTÃO AMBIENTAL

Certificado N° 3087-2004-AE-SPA-INMETRO

A DET NORSKE VERITAS CERTIFICADORA LTDA. certifica que o Sistema de Gestão Ambiental da organização

CDR PEDREIRA

CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA.

em

Estrada da Barrocada, 7.450
São Paulo, SP - Brasil

está em conformidade com os requisitos da Norma

NBR ISO 14001:1996

para o seguinte escopo de produtos e serviços:

ATERRO SANITÁRIO PARA CODISPOSIÇÃO DE RESÍDUOS SÓLIDOS DOMICILIARES E INDUSTRIAIS CLASSE II E III.

Local e data de emissão:
São Paulo, 2004-02-06

Pelo Organismo Credenciado:
DET NORSKE VERITAS CERTIFICADORA LTDA.
BRASIL

Maurício Venturin
Gerente de Certificação

INMETRO

Este Certificado é válido até:
2007-01-30

Data da Certificação original:
2004-01-30

A conformidade com a Norma para o escopo indicado foi verificada pelo Auditor Líder
SILVIO HIRATA
registrado pela DNV

A não observância das condições estabelecidas no Apêndice pode tornar este Certificado inválido

DET NORSKE VERITAS - Rua Sete de Setembro, 111 - 12°/14° andares - Rio de Janeiro, RJ - Brasil - CEP 20050-006

Figure 1 - ISO 14001 certificate

A.3. Project participants:

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 wishes to be considered as project participant (Yes/No)
Brazil (host)	• Brazilian private entity: CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA • Brazilian Private entity: Econergy Brasil Ltda.	No
(*) 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.		

One of CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA’s shareholders is ESTRE (Empresa de Saneamento e Tratamento de Resíduos), a 100% Brazilian company, founded in 1999. With its core business in the sanitation and waste treatment and final destination, ESTRE brought to Brazil various success experiences.

The company provides adequate solutions for final destination of waste class II-A and II-B[1], generated by municipalities, commerce and industrial companies.

ESTRE is present in the main metropolitan centers of state of São Paulo (São Paulo metropolitan region, Campinas metropolitan region, and Santos region). With the goal of adequately dispose industrial and municipal waste produced in such regions, ESTRE has already implemented five landfills.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

CDR Pedreira landfill is located in the Northeast region of São Paulo, capital of São Paulo state, at Estrada da Barrocada, 7 450 – Tremembé district.

A.4.1.1. Host Party(ies):

Brazil

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

São Paulo

A.4.1.3. City/Town/Community etc:

São Paulo

[1] Residues in Brazil are classified under standard NBR 10004, from ABNT, from November 2004. Class I residues are classified as hazardous or present one of the following characteristics: flammability, power of corrosion, reactive properties, toxicity and pathogenicity. Class II residues are classified as non-hazardous residues and divided into II-A Class – Non-Inerts, not classified as Class I residues nor Class II-B, might present the following characteristics: biodegradability, power of combustion or water solubility. Class II-B residues are inerts, not presenting constitutants when solubilized in standard above the potable water

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

The Figure 2 shows the location of São Paulo and CDR Pedreira.

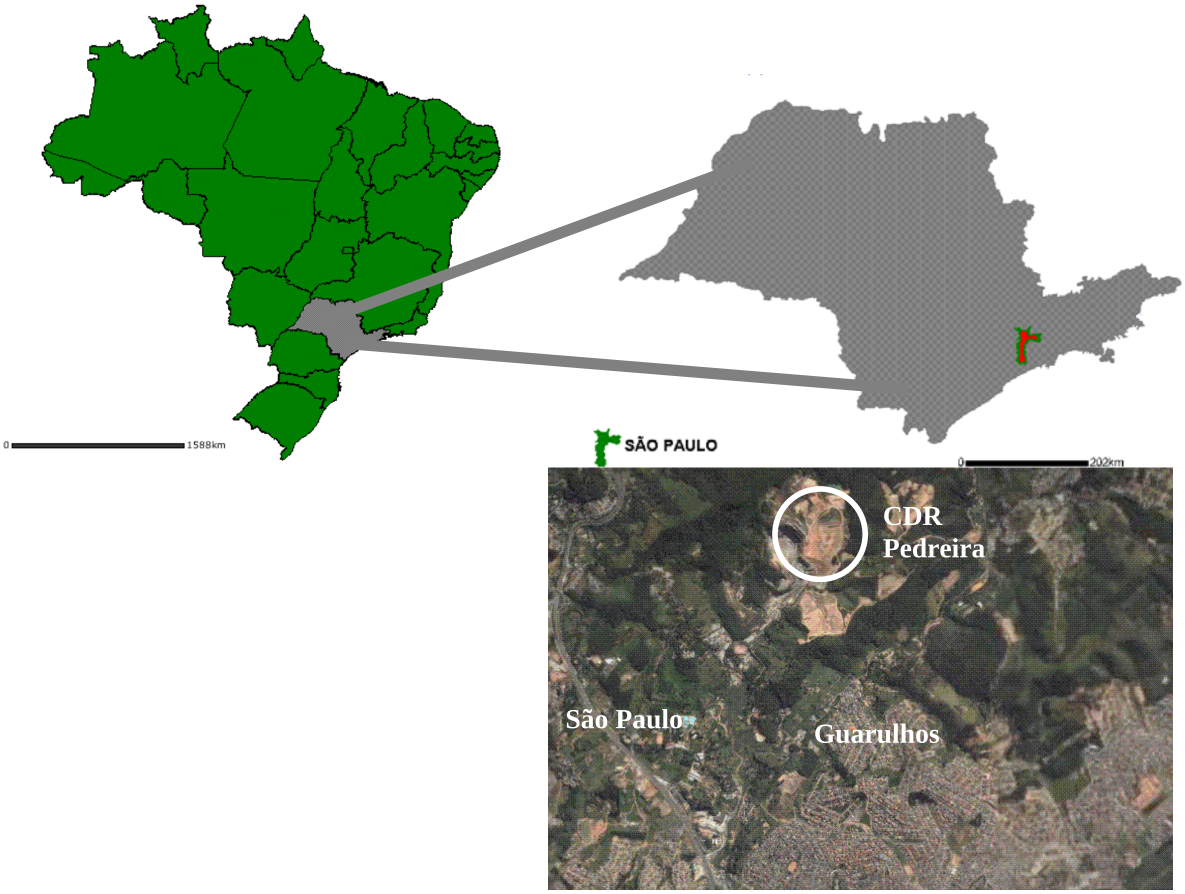


Figure 2. São Paulo location (Source: IBGE[2] and Google Earth)

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

EPLGP is designed as a Sectoral Scope 13 – waste handling and disposal – project.

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

The technology to be employed will be the improvement of landfill gas collection and flaring, through the installation of an active recovery system composed by a collection and transportation pipeline network and a flaring system, as shown in Figure 3.

[2] Adapted from <http://mapas.ibge.gov.br >

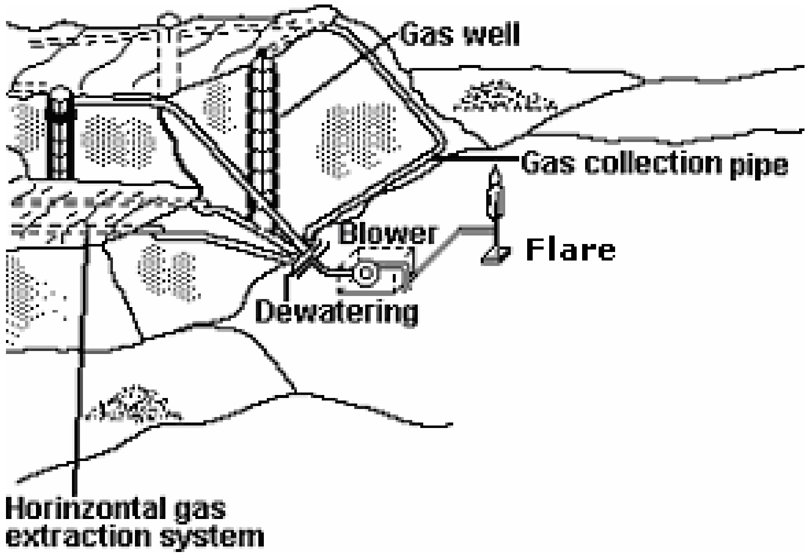


Figure 3. Schematic situation of a landfill with active gas recovery (Source: WILHELM, 1991)

Following concrete examples from other landfill gas projects in the world, the EPLGP may involve the installation of wellheads at the existing concrete wells to avoid the emission of methane to the atmosphere. An example of wellhead and the detail of its construction are shown on Figure 4 and Figure 5.

Figure 4. Example of wellhead (source: Biogás Ambiental[3])

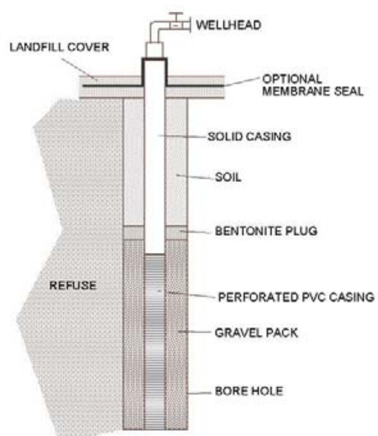


Figure 5. Internal detail of a well and wellhead

The use of the existing wells represents a distinct advantage since they are already installed and because at that location most of the gas flows to the atmosphere. However, some physical barriers might interrupt the gas flow from the generation point to the well, so new wells might need to be drilled.

[3] Biogás Ambiental: available at <http://www.biogas-ambiental.com.br/instalacaorede.htm>; accessed on Jan 31st, 2006.

A common practice all over the world is to use PVC equipment. It has de advantage to be more flexible and more resistant to high pressure, if compared to metal or concrete equipment. The disadvantage is represented by the high cost involved.

The wellheads are connected to a collecting pipeline. This pipeline transports the landfill gas to the manifolds. The manifolds are equipment that can be connected with more than 10 wellheads and transfer the collected gas to the transmission pipeline.

Figure 6. Example of manifold, connected with the transmission pipeline

The transmission pipeline is the last step of the collecting system. It transports the collected landfill gas to the flare. The transmission pipeline might be connected with all manifolds around the landfill.

In order to preserve the operation of the equipment, a dewatering system might be installed to remove the condensate.

Figure 7. Example of a transmission pipeline

The collecting pipeline and the transmission pipeline are both usually in PVC, because this material can support high pressures and is flexible. The transmission pipeline is finally connected to the flare.

Figure 8. Example of flares (source: Biogás Ambiental)

This kind of technology is still not widely applied in Brazil. Very few landfills have already installed equipment for improving the amount of landfill gas collected. Therefore, CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. will need engineers and other specialists with experience in this area to advice the company while implementing the project. These professionals will also train local operators and engineers on operations and maintenance of the facilities.

Despite the fact that landfill gas projects can be of great potential in Brazil, the local market does not have flare suppliers. Technology will have to come from abroad and mainly from the United States and Europe. Technology transfer will hence occur from countries with strict environmental legislative requirements and environmentally sound technologies. Environmentally sound technologies are also needed for CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. to comply with its environmental guidelines.

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

Years	Annual estimation of emission reductions in tonnes of CO_2e
2007 [1]	55 481
2008	130 415
2009	149 587
2010	169 998
2011	194 594
2012	220 934
2013	247 321
2014 [1]	135 876
Total estimated reductions (tonnes of CO_2e)	**1 304 206**
Total Number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**186 315**

[1] Obs: the first crediting period will be from 01/07/2007 to 30/06/2014

A.4.5. Public funding of the project activity:

There is no Annex I public funding involved in this 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:

- Version 05 of ACM0001: *"Consolidated baseline methodology for landfill gas project activities"*;
- Version 06 of ACM0002: *"Consolidated Methodology for grid-connected electricity generation from renewable sources"*;
- Version 02 of the *"Tool for demonstration and assessment of additionality";*
- Version 01 of the *"Methodological Tool to determine project emissions from flaring gases containing methane"*.

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

These methodologies are applicable to the EPLGP because the baseline scenario is the partial or total atmospheric release of the gas and the project activities is the capture of the gas through a blower and the installation of a collecting system and the use of a flare to burn the methane.

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

	Source	Gas	Included?	Justification / Explanation
Baseline	Baseline emissions	CO_2	No	
		CH_4	Yes	Natural methane emissions due to the decomposition of the waste.
		N_2O	No	
Project Activity	Electricity consumption	CO_2	Yes	Electricity consumed by the LFG blower and/or electricity produced by diesel engines installed.
		CH_4	No	
		N_2O	No	

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

The baseline scenario is the natural emission of the LFG (generated due to the decomposition of the waste) to the atmosphere as a continuation of the landfill's operation (business as usual situation). As per security and odor concerns, it's estimated that about 20% of the total LFG generated is burned in the concrete wells.

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):

Application of the Tool for the demonstration and assessment of additionality.

Step 0. Preliminary screening based on the starting date of the project activity

Since the EPLGP will start its activities after the prompt-start date of 18/11/2004, the project participants will not benefit from the crediting period starting prior to the registration of the project activity. Thus Step 0 is not applicable.

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

Sub-step 1a: Define alternatives to the project activity
Since the project activity will not deliver commercial goods or services (i.e. electricity generation or thermal energy) and no other incentives will be obtained from the capture and flaring of the methane, and taking into account that there is no legislation that obligates the landfill to destroy the methane, the landfill would continue with its core business (final disposal of solid waste) and the methane would continue to be released to the atmosphere, according with the baseline scenario.

Sub-step 1b: Enforcement of applicable laws and regulations
The alternative, which is to continue with the business as usual situation before the decision of implementing this CDM project activity is consistent with Brazilian laws and regulations.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method
As the CDM project activity does not generate any financial or economic benefit other than CDM related income, the simple cost analysis scenario is applied.

Sub-step 2b. – Option I. Apply simple cost analysis
As the baseline scenario is in accordance with national laws and regulations and as the project activity will not receive income from the sale of electricity or methane, the implementation of the project activity will have no other benefit than the CDM revenue.

Step 4. Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity
According to the latest official statistics on urban solid waste in Brazil – *Pesquisa Nacional de Saneamento Básico 2000* (PNSB 2000) – the country produces 228,413 tons of waste per day, which corresponds to 1.35 kg/inhabitant/day. And though there is a worldwide trend towards reducing, reusing and recycling, therefore reducing the amount of urban solid waste to be disposed in landfills, the situation in Brazil is peculiar. Most of the waste produced in the country is sent towards open dumps which are, in most of the cases, areas without any sort of proper infrastructure to avoid environmental hazards. Figure 9 shows the final destination of the waste per municipality, according to PNSB 2000.

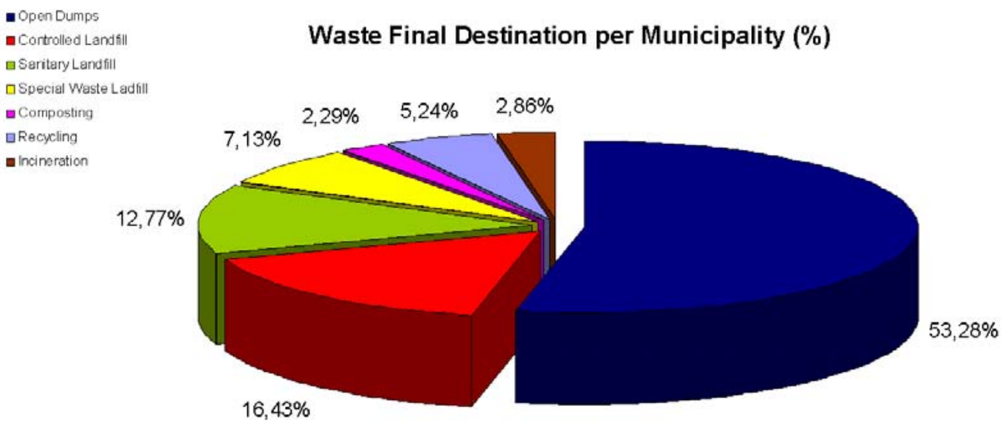


Figure 9. Waste Final Destination per Municipality in Brazil (Source: PNSB, 2000)

Only few of the existing Brazilian landfills have installed a collecting and flaring methane system. The majority of landfills operate with natural emission of methane to the atmosphere, through concrete wells.

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

Some landfills operate with a forced methane extraction and destruction using blowers, collection systems and flaring systems: Bandeirantes Landfill, Nova Gerar Landfill, Onyx Landfill, Marca Landfill, Sertãozinho Landfill, Salvador da Bahia Landfill and ESTRE Paulínia Landfill.

This kind of project activity is not widely spread in Brazil and the landfills that operate this type of project represent only a small portion of the total existing landfills.

Step 5. Impact of CDM registration

CDM registration will reduce the economic and financial barriers to the project activity. The commercialization of the generated CERs represents the sole benefit of the project. Registration will reduce investment risk and foster the project owners into expanding business activities.

The benefits and incentives mentioned in the text of the Tool for demonstration and assessment of additionality, published by the CDM-EB, will be experienced by the project: anthropogenic GHG reductions; financial benefits from the revenue obtained by selling CERs; and, likelihood to attract new players and new technologies (currently there are companies developing new technologies of biogas extraction and extra-efficient flares and the purchase of such equipment is to be fostered by the CER sales revenue) thus reducing investor's risk.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The Methodology ACM0001 states that greenhouse gas emission reduction achieved by the project activity during a given year "*y*" (ER_y) is the difference between the amount of methane actually destroyed/combusted during the year ($MD_{project,\ y}$) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg\ ,y}$), times the approved Global Warming Potential value for methane (GWP_{CH4}), plus the emission reductions of the net electricity fed to the grid ($EL_{EX, LGFG} - EL_{IMP}$) minus the emission reduction due to the replacement of the fossil fuel used in the baseline, as follows:

$$ER_y = \left(MD_{project,y} - MD_{reg,y}\right) \times 21 + \left(EL_{EX,LGFG} - EL_{IMP}\right) \times CEF_{electricity} - ET_y \times CEF_{thermal} ,$$

where:
ER_y = emission reductions of the project activity in year y (tCO_2e);
$MD_{project, y}$ = quantity of methane destroyed at year y (tCH_4);
$MD_{reg, y}$ = methane that would have been destroyed during the year y in the absence of the project activity (tCH_4);
GWP_{CH4} = Global Warming Potential of Methane (tCO_2e/tCH_4);
$EL_{EX, LGFG}$ = net quantity of electricity exported during year y, produced using landfill gas (MWh).
EL_{IMP} = net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements (MWh);
$CEF_{electricity}$ = CO_2 emissions intensity of the electricity displaced (tCO_2e/MWh);
ET_y = incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year y (TJ);
$CEF_{thermal}$ = CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy, (tCO_2e/TJ);

As the EPLGP is not a project to produce and sell electricity to the grid and as the landfill did not consume fossil fuel for energy requirements in the baseline, $EL_{EX, LGFG} = 0$ and $ET_y = 0$.

So, the formula is updated to:

$$ER_y = \left(MD_{project,y} - MD_{reg,y}\right) \times 21 - EL_{IMP} \times CEF_{electricity}$$

The EPLGP does not have any contractual obligations to burn methane; so $MD_{reg, y}$ is calculated based on the “Adjustment Factor”, a value estimated as 20% of total methane produced at the baseline that is flared due to odor and security concerns:

$$MD_{reg,y} = 0{,}2 \times MD_{project,y}$$

and

$$ER_y = 0{,}8 \times MD_{project,y} \times 21 - EL_{IMP} \times CEF_{electricity}$$

As the project won’t produce electricity or replace a fossil fuel consumed in the baseline, the methane destroyed by the project activity $MD_{project, y}$ during year y is determined by monitoring only the quantity of methane actually flared:

$$MD_{project,y} = MD_{flared,y}$$

and

$$MD_{flared,y} = LFG_{flared,y} \times w_{CH_4} \times D_{CH_4} \times FE \text{ , where}$$

$MD_{flared, y}$ = quantity of methane destroyed by flaring during year y (tCH_4);
$LFG_{flared, y}$ = quantity of landfill gas flared during the year (Nm^3_{LFG});
$w_{CH4,y}$,= methane fraction of the landfill gas (Nm^3CH_4/Nm^3_{LFG});

D_{CH4} = methane density (0,0007168 t_{CH4}/Nm^3_{CH4} at 0ºC and 1,013 bar);
FE = flare efficiency (%).

The estimate of the amount of landfill gas produced during year y is shown in B.6.3. The data used to determine the baseline scenario is presented in Annex 3.

In other words, ER_y is equal to:

$$ER_y = \left(0{,}8 \times LFG_{flared,y} \times w_{CH_4} \times D_{CH_4} \times FE \times 21\right) - EL_{IMP} \times CEF_{electricity}$$

$LFG_{flared,\ y}$ was estimated using IPCC's guidelines[4]. In the case of EPLGP, the derivative of first order decay model approach was used:

$$LFG_{flared,y} = CE \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)}\right]}{F}$$, where:

- *CE* = collection efficiency (%);
- *k* = decay constant (1/year);
- R_y = amount of waste disposed on year *y* (kg);
- L_0 = methane potential generation (m^3_{CH4}/Mg_{waste});
- *T* = actual year;
- *y* = year of waste disposal;
- *F* = fraction of methane at the landfill gas (%).

Thus, the ER_y is calculated as follows:

$$ER_y = \left(0{,}8 \times CE \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)}\right]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21 \right) - EL_{IMP} \times CEF_{electricity}$$

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

Data / Parameter:	**CE**
Data unit:	%
Description:	Collection Efficiency
Source of data used:	**USEPA**; *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*; September 1996
Value applied:	65%
Justification of the choice of data or description of	According with USEPA, collection efficiency for energy recovery between 75% and 85% sounds reasonable "because each cubic foot of gas will have a monetary value to the owner/operator". A conservative value of 65% was

[4] Revised 1996 IPCC Guidelines for National Greenhouse Gases Inventory.

measurement methods and procedures actually applied :	adopted. So, $LFG_{flare,y}$ is equal to 65% of total landfill gas emitted to the atmosphere at the baseline
Any comment:	

Data / Parameter:	**k**
Data unit:	1/year
Description:	Decay Constant
Source of data used:	**USEPA**; *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*; September 1996
Value applied:	0,1
Justification of the choice of data or description of measurement methods and procedures actually applied :	It was chosen this parameter as *0,1/year*, upper from the lowest of the suggested value, considering a wet climate.
Any comment:	

Data / Parameter:	**R_y**
Data unit:	t_{waste}
Description:	Tons of waste disposed in year *y*
Source of data used:	CDR Pedreira
Value applied:	Variable
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimative from CDR Pedreira of waste received.
Any comment:	Estimated based on CDR Pedreira's project.

Data / Parameter:	**L_0**
Data unit:	m^3_{CH4}/kg_{waste}
Description:	Methane Potential Generation
Source of data used:	**USEPA**; *Turning a Liability into an Asset: A Landfill Gas-to-Energy Project Development Handbook*; September 1996
Value applied:	0,06 m^3_{CH4}/kg_{waste}
Justification of the choice of data or description of measurement methods and procedures actually applied :	The source suggest values of *k* and L_0 to be applied to the model. Because of the uncertainty in estimating L_0, gas flow estimates derived from the model should also be bracketed by a range of plus or minus 50 percent. To make a conservativeness approach, L_0 was assumed to be minus 50% of the lowest value of the range (2,25-2,88 ft^3/lb). Converting the units to m^3_{CH4}/kg_{waste}, the value assumed for L_0 is *0,06*.
Any comment:	

Data / Parameter:	**EF**
Data unit:	tCO_2e/MWh

Description:	CO_2 emission of the grid
Source of data used:	ONS
Value applied:	0.2611
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as weighted sum of the OM and BM emission factor, as explained in Annex 3. Required to determine CO_2 emissions from use of electricity to operate the project activity.
Any comment:	

Data / Parameter:	**EF_{BM}**
Data unit:	tCO_2e/MWh
Description:	Build Margin
Source of data used:	ONS
Value applied:	0.0872
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as explained in Annex 3. Required to determine CO_2 emissions from use of electricity to operate the project activity.
Any comment:	

Data / Parameter:	**EF_{OM}**
Data unit:	tCO_2e/MWh
Description:	Operating Margin
Source of data used:	ONS
Value applied:	0.4349
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as explained in Annex 3. Required to determine CO_2 emissions from use of electricity to operate the project activity.
Any comment:	

Data / Parameter:	**Regulatory requirements relating to landfill gas projects**
Data unit:	N/A
Description:	Legal requirements of methane destruction.
Source of data used:	National Legislation or any other applicable.
Justification of the choice of data or description of measurement methods and procedures actually applied :	As there is no obligation to burn the gas produced, a conservative value of 20% was applied.
Any comment:	Required for any changes to the adjustment factor (AF), at the renewal of the crediting period.

B.6.3 Ex-ante calculation of emission reductions:

As mentioned on B.6.1, the calculation of emission reductions for a certain year *y* will be calculated through the formula below:

$$ER_y = \left(0{,}8 \times CE \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^{T} \sum_{j=y}^{i} \left[e^{-k(i-j)} \right]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21 \right) - EL_{IMP} \times CEF_{electricity}$$

The following data is applied to the formula:

Year of Opening	2001
Year of Closure	2020
Daily Waste Flow (t/day)	Variable
Collection Efficiency (%)	65%
Flare Efficiency (%)	90%
Blower consumption (MWh/year)	3.000
Emission Factor (tCO_2e/MWh)	0.2611
k (1/year)	0,1
L_0 ($m^3_{methane}/kg_{waste}$)	0,06

a) Baseline emissions:

Appling the derivative of the First Order Decay Model, the methane baseline estimative is:

Table 1. Estimative of methane emissions in the baseline

Year	LFG emissions (Nm^3_{lfg})	Methane Emissions (Nm^3_{CH4})	Year	LFG emissions (Nm^3_{lfg})	Methane Emissions (Nm^3_{CH4})
2003	9.811.665	4.905.832	2021	96.155.555	48.077.778
2004	16.196.689	8.098.345	2022	87.005.144	43.502.572
2005	21.025.604	10.512.802	2023	78.725.510	39.362.755
2006	26.059.331	13.029.665	2024	71.233.787	35.616.894
2007	31.552.258	15.776.129	2025	64.454.996	32.227.498
2008	37.247.263	18.623.632	2026	58.321.292	29.160.646
2009	42.690.237	21.345.119	2027	52.771.288	26.385.644
2010	48.485.004	24.242.502	2028	47.749.436	23.874.718
2011	55.467.846	27.733.923	2029	43.205.476	21.602.738
2012	62.945.863	31.472.931	2030	39.093.931	19.546.966
2013	70.437.052	35.218.526	2031	35.373.652	17.686.826
2014	78.230.080	39.115.040	2032	32.007.404	16.003.702
2015	85.281.504	42.640.752	2033	28.961.497	14.480.748
2016	91.661.896	45.830.948	2034	26.205.446	13.102.723
2017	97.435.113	48.717.556	2035	23.711.668	11.855.834
2018	102.658.936	51.329.468	2036	21.455.204	10.727.602
2019	107.385.647	53.692.823	2037	19.413.472	9.706.736
2020	106.268.323	53.134.162	2038	-	-

b) Project emissions:

The only source of GHG project emissions is the CO_2 emissions due to the import of electricity, calculated multiplying the grid's Emission Factor (EF) by the amount of electricity imported, in MWh, as presented on Annex 3.

As demonstrated on Annex 3, the EF for the S-SE-CO Brazilian electric grid is equal to 0.2611 tCO_2e/MWh. Assuming that the blower is estimated to need around 3 000 MWh/year (imagining a 380 kW blower installed). That gives emission due to the import of electricity equals to 783 tCO_2e/year.

c) Leakage

According with ACM0001 – version 5, no Leakage emissions need to be considered for EPLGP.

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

Year	Estimation of project activity emission (tonnes of CO_2e)	Estimation of the baseline emission (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2007	394	55.874	0	55.481
2008	783	131.198	0	130.415
2009	783	150.370	0	149.587
2010	783	170.781	0	169.998
2011	783	195.377	0	194.594
2012	783	221.718	0	220.934
2013	783	248.104	0	247.321

2014	387	136.263	0	135.876
TOTAL	**5.481**	**1.309.687**	**0**	**1.304.206**

*Obs: the crediting period will be from 01/07/2007 to 30/06/2014.

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$LFG_{flare, y}$**
Data unit:	m^3
Description:	Amount of landfill gas collected and sent to flares
Source of data to be used:	Readings from the flow-meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Variable (see Table 1).
Description of measurement methods and procedures to be applied:	Continuous readings from the flow-meter installed. The equipment is connected to a supervisory computer system, which measures continuously the LFG measured.
QA/QC procedures to be applied:	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	- Modern flow-meters usually include temperature and pressure readings. Thus, they automatically converts the flow measured to Nm^3; - Calibration of the equipment will be made according with the manufacturers recommendations; - Monitoring under responsibility of the EPLGP's operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

Data / Parameter:	**FE**
Data unit:	%
Description:	Flare Efficiency
Source of data to be used:	Measurements of the temperature of the combustion chamber, according with the *"Methodological Tool to determine project emissions from flaring gases containing methane – version 1"*
Value of data applied for the purpose of calculating expected emission reductions in section B.5	90%
Description of measurement methods and procedures to be applied:	The approach selected from the *"Methodological Tool to determine project emissions from flaring gases containing methane – version 1"* was to monitor the temperature of the exhaust gas of the flare. The temperature measurements will be done continuously. The measure will be done by a Type N thermocouple. The readings of temperature will be made by a computer based system, with continuous storage. If the temperature read is below 500ºC for any particular hour, then the flare efficiency during that hour is zero.

	By the time of validation the flare was not installed. Thus, the specifications of the flare's manufacturer will be available during the verification stage.
QA/QC procedures to be applied:	Thermocouples will be replaced or calibrated according with the manufacturer's specifications.
Any comment:	Monitoring of under responsibility of the EPLGP operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

Data / Parameter:	$\mathbf{w_{CH4,\,y}}$
Data unit:	m^3_{CH4}/m^3_{LFG}
Description:	Methane fraction in the landfill gas
Source of data to be used:	Readings from Gas Analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	50 %
Description of measurement methods and procedures to be applied:	Continuous measurements from gas quality analyzer.
QA/QC procedures to be applied:	The gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	Monitoring under responsibility of the EPLGP's operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

Data / Parameter:	**T**
Data unit:	^oC
Description:	Temperature of the LFG.
Source of data to be used:	Readings from the temperature-meter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0 ^oC
Description of measurement methods and procedures to be applied:	Direct readings from the temperature-meter installed. The equipment is connected to a supervisory computer system, which counts continuously the temperature measured.
QA/QC procedures to be applied:	Flow meters with temperature reading should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	- Modern flow-meters usually include temperature and pressure readings. Thus, they automatically converts the flow measured to Nm^3; - Calibration of the equipment will be made according with the manufacturers recommendations.

	- Monitoring under responsibility of the EPLGP's operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

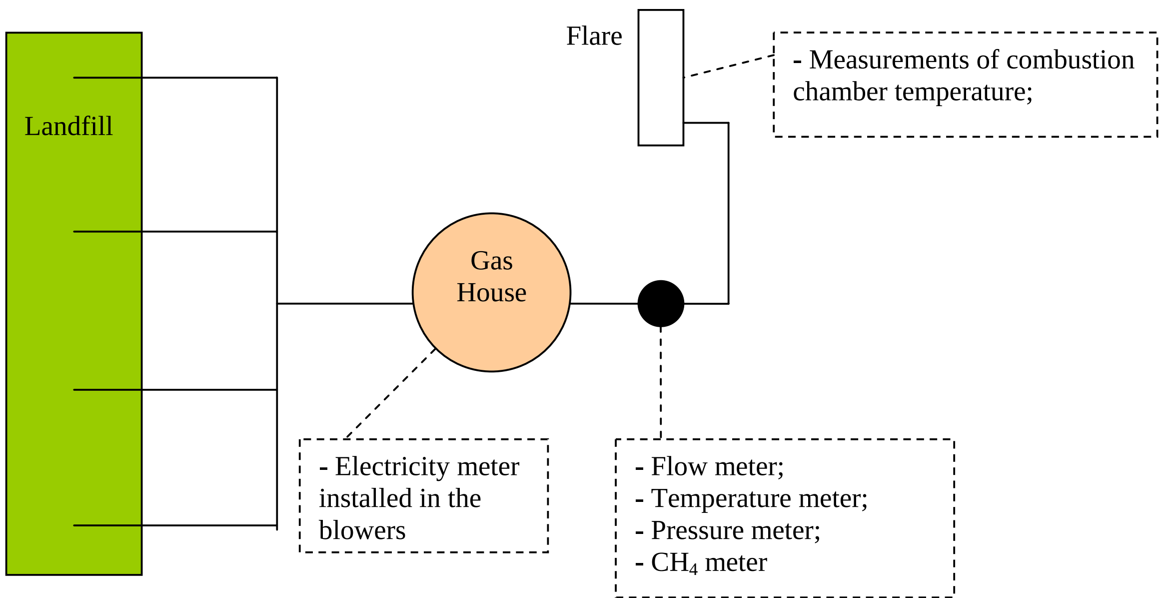
Data / Parameter:	**p**
Data unit:	Pa
Description:	Pressure of the LFG.
Source of data to be used:	Readings from the pressure-meter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	101 325 Pa
Description of measurement methods and procedures to be applied:	Direct readings from the pressure-meter installed. The equipment is connected to a supervisory computer system, which counts continuously the pressure measured.
QA/QC procedures to be applied:	Flow meters with pressure reading should be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	- Modern flow-meters usually include temperature and pressure readings. Thus, they automatically converts the flow measured to Nm^3; - Calibration of the equipment will be made according with the manufacturers recommendations. - Monitoring under responsibility of the EPLGP's operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

Data / Parameter:	$\mathbf{EL_{imp}}$
Data unit:	MWh
Description:	Electricity consumed by the blowers
Source of data to be used:	Readings from the electricity meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3 000 MWh/year
Description of measurement methods and procedures to be applied:	Direct readings from the electricity-meter installed. The equipment is connected to a supervisory computer system, which counts continuously the electricity measured.
QA/QC procedures to be applied:	According with ACM0001 – version 5, no QA/QC procedures are listed.
Any comment:	- Calibration of the equipment will be made according with the manufacturers recommendations or according with any national standard; - Monitoring under responsibility of the EPLGP's operators (the team, the organizational structure and the management structure will be defined after the project's implementation).

B.7.2 Description of the monitoring plan:

The following variables need to be measured as to determine and account for emission reductions due to EPLGP.

- The amount of landfill gas being sent to flares;
- The amount of methane in the landfill gas;
- The flares' efficiencies.
- The pressure of the LFG;
- The temperature of the LFG; and
- The electric consumption of the blower, in MWh.



According with ACM0001, when a landfill project only flares the methane, only one flow-meter must be installed provided that the meter used is calibrated periodically by an officially accredited entity.

Except from the methane content in the flue gas, all other data need to be monitored continuously, through proper meters or analyzers. The flare efficiency will be monitored by the combustion chamber temperature, and the landfill gas flow to the flare system. Will not be measured the methane content in the flue gas.

Considering EPLGP's facilities will have computer-based equipment and generate continuous data, such equipment will be used for generating data relevant for the annual emission reduction verification report. A model of the summary table (Table 2) for such report will be filled in, with the metered data provided as background.

Table 2. Summary Worksheet

DAY	Total EPLGP - Estre Pedreira Landfill Gas Project														
	LFG Collected (m3)	Temperature (°C)	Pressure (mbar)	LFG Collected (Nm3)	Methane (%)	Methane Collected (Nm³)	Temperature FLARE#1 (°C)	Hours of Operation FLARE#1	Temperature FLARE#2 (°C)	Hours of Operation FLARE#2	Flare Efficiency (%)	Methane Destroyed (Nm3)	Electricity Consumed from the Grid(MWh)	Electricity Procudec by Diesel Engines (MWh)	Total CERs (tCO2e)
1/8/2007			36,0000	0,0000	52,2	0,0000					99,78%	0,0000			0,0000
2/8/2007				0,0000		0,0000						0,0000			0,0000
3/8/2007				0,0000		0,0000						0,0000			0,0000
4/8/2007				0,0000		0,0000						0,0000			0,0000
5/8/2007				0,0000		0,0000						0,0000			0,0000
6/8/2007				0,0000		0,0000						0,0000			0,0000
7/8/2007				0,0000		0,0000						0,0000			0,0000
8/8/2007				0,0000		0,0000						0,0000			0,0000
9/8/2007				0,0000		0,0000						0,0000			0,0000
10/8/2007				0,0000		0,0000						0,0000			0,0000
11/8/2007				0,0000		0,0000						0,0000			0,0000
12/8/2007				0,0000		0,0000						0,0000			0,0000
13/8/2007				0,0000		0,0000						0,0000			0,0000
14/8/2007				0,0000		0,0000						0,0000			0,0000
15/8/2007				0,0000		0,0000						0,0000			0,0000
16/8/2007				0,0000		0,0000						0,0000			0,0000
17/8/2007				0,0000		0,0000						0,0000			0,0000
18/8/2007				0,0000		0,0000						0,0000			0,0000
19/8/2007				0,0000		0,0000						0,0000			0,0000
20/8/2007				0,0000		0,0000						0,0000			0,0000
21/8/2007				0,0000		0,0000						0,0000			0,0000
22/8/2007				0,0000		0,0000						0,0000			0,0000
23/8/2007				0,0000		0,0000						0,0000			0,0000
24/8/2007				0,0000		0,0000						0,0000			0,0000
25/8/2007				0,0000		0,0000						0,0000			0,0000
26/8/2007				0,0000		0,0000						0,0000			0,0000
27/8/2007				0,0000		0,0000						0,0000			0,0000
28/8/2007				0,0000		0,0000						0,0000			0,0000
29/8/2007				0,0000		0,0000						0,0000			0,0000
30/8/2007				0,0000		0,0000						0,0000			0,0000
31/8/2007				0,0000		0,0000						0,0000			0,0000

Landfill gas into flares and methane content in the landfill gas are metered through a flow meter and a gas analyzer installed at the facility and monitored electronically through a programmable logic control system. After that, once the flow, as well as flares' efficiencies, become inputs for the sheet, the amount flared is calculated. The sum of both quantities is the total methane destroyed. Discounting such number by 20% (Effectiveness Adjustment Factor), the emission reductions from the project are determined.

There will be similar sheets for the three crediting periods. They will be presented to the verifier as the collected and stored data for verification purposes.

There will be a team assigned to monitor emission reductions from the project. They will be responsible for collecting and archiving the pertinent data according to the monitoring plan.

The team and the operational and management structure and the responsibility of each member will be defined by the time of the project operation.

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)

The baseline study and monitoring methodology was completed on 02/02/2007, by Econergy Brasil Ltda. See contact information in Annex I.

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:

01/07/2007

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

21y – 0m

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:

01/07/2007

C.2.1.2. Length of the first crediting period:

7y – 0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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C.2.2.2. Length:

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SECTION D. Environmental impacts

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

The possible environmental impacts are to be analyzed by CETESB – São Paulo environmental agency. CDR Pedreira has all the licenses for the landfill's operation, and will carry out the necessary process in order to obtain the Operational License for the EPLGP's facilities.

According to the "Resolução CONAMA 01", all pollution sources must be analyzed via an EIA – Estudo de Impacto Ambiental. CDR Pedreira developed an EIA to the landfill's environmental licensing process. The conclusion of the Assess was that the landfill is adequate from the environmental point of view. The environmental impacts analyzed are low and the ecosystem is capable to absorb possible changes on its actual quality.

The landfill encompasses different systems of environmental protection and is also benefit the area used belong to a mining company and the operation of the landfill, as described, will recover all impacts from the previous activity.

The adoption of these two practices – natural resources protection systems and the use of an old mining area – generates an economy of the region's natural resources as the same area will be recovered and used to install a pollution source that might have minimum impact if operated as described.

The CDR Pedreira landfill's Operation License is shown in Figure 10 and Figure 11.

There will be no transboundary impacts resulting from the EPLGP. All relevant impacts will occur within Brazilian borders and will be mitigated to comply with the environmental requirements for the project's implementation.

GOVERNO DO ESTADO DE SÃO PAULO
SECRETARIA DO MEIO AMBIENTE
CETESB - COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

02

Processo Nº 29/00930/00

Nº 29002236

Data 06/09/2005

LICENÇA DE OPERAÇÃO PARCIAL

VALIDADE ATÉ : 06/09/2010

de Novo Estabelecimento LO PARCIAL

IDENTIFICAÇÃO DA ENTIDADE

Nome: CDR PEDREIRA - CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA.
CNPJ: 04.434.120/0001-58
Logradouro: ESTRADA DA BARROCADA
Cadastro na CETESB: 100 - 47281 - 6

Número	Complemento	Bairro	CEP	Município
7450		TREMEMBÉ	02282-000	SÃO PAULO

CARACTERÍSTICAS DO PROJETO

Atividade Principal

Descrição	Código
ATERRO SANITÁRIO	9000-0/02

Bacia Hidrográfica	UGRHI
2 - TIETÊ ALTO ZONA METROPOLITANA	6 - ALTO TIETÊ

Corpo Receptor
Classe 4

Área (metro quadrado)

Terreno	Construída	Atividade ao Ar Livre	Novos Equipamentos	Lavra(ha)
1022231,00		15615,00		

Horário de Funcionamento (h)			Número de Funcionários		Licença de Instalação	
Início		Término	Administração	Produção	Data	Número
06:00	às	06:00	5	20	30/03/2001	29000813

A CETESB-Companhia de Tecnologia de Saneamento Ambiental, no uso das atribuições que lhe foram conferidas pela Lei Estadual nº 997, de 31 de maio de 1976, regulamentada pelo Decreto nº 8468, de 8 de setembro de 1976, e suas alterações, concede a presente licença, nas condições e termos nela constantes;

A presente licença está sendo concedida com base nas informações apresentadas pelo interessado e não dispensa nem substitui quaisquer Alvarás ou Certidões de qualquer natureza, exigidos pela legislação federal, estadual ou municipal;

A presente Licença de Operação refere-se aos locais, equipamentos ou processos produtivos relacionados em folha anexa;

Os equipamentos de controle de poluição existentes deverão ser mantidos e operados adequadamente, de modo a conservar sua eficiência;

No caso de exigência de equipamentos ou dispositivos de queima de combustível, a densidade da fumaça emitida pelos mesmos deverá estar de acordo com o disposto no artigo 31 do Regulamento da Lei Estadual nº 997, de 31 de maio de 1976, aprovado pelo Decreto nº 8468, de 8 de setembro de 1976, e suas alterações;

Alterações nas atuais atividades, processos ou equipamentos deverão ser precedidas de Licença Prévia e Licença de Instalação, nos termos dos artigos 58 e 58-A do Regulamento acima mencionado;

Caso venham a existir reclamações da população vizinha em relação a problemas de poluição ambiental causados pela firma, esta deverá tomar medidas no sentido de solucioná-los em caráter de urgência;

A renovação da licença de operação deverá ser requerida com antecedência mínima de 120 dias, contados da data da expiração de seu prazo de validade.

USO DA CETESB	EMITENTE
SD Nº 29003082	Local: São Paulo

ENTIDADE

Pág. 1

AUTENTICAÇÃO
16 SET 2005

CETESB COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

Engº MAURO KAZUO SATO
Gerente da Agência
Ambiental de Santana
Reg. 01.2595-4 CREA 87 719/D

AUTENTICAÇÃO
0673AC075205

0956646

Figure 10 - CDR Pedreira Operational License (page 1 of 2)

GOVERNO DO ESTADO DE SÃO PAULO
SECRETARIA DO MEIO AMBIENTE
CETESB - COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

02

Processo Nº 29/00930/00

LICENÇA DE OPERAÇÃO PARCIAL

Nº 29002236

Data 06/09/2005

EXIGÊNCIAS TÉCNICAS

1. Fica proibida a emissão de substâncias odoríferas na atmosfera, em quantidades que possam ser perceptíveis fora dos limites de propriedade do empreendimento.
2. Deverá ser apresentado cronograma detalhado de execução das obras de infra-estrutura da segunda etapa do aterro.
3. Quanto ao encaminhamento de líquidos percolados à Estação de Tratamento de Esgotos da SABESP, por caminhão-tanque, a empresa deverá manter registro diário das viagens, com identificação dos veículos e dos volumes transferidos. Informar à CETESB, trimestralmente, os totais de viagens e volumes de líquidos percolados transportados. Os líquidos percolados deverão atender aos padrões do artigo 19-A do Regulamento da Lei nº 997/76, aprovado pelo Decreto nº 8468/76.
4. Não poderão ser dispostos no aterro resíduos contendo líquidos livres, conforme estabelecido na norma NBR 13.896 - "Aterros de Resíduos Não Perigosos - Critérios para Projeto, Implantação e Operação". Para tal verificação, deverá ser utilizada a norma NBR 12.988 - " Líquidos Livres - Verificação em Amostra de Resíduo".
5. Os resultados das análises de monitorização da qualidade das águas superficiais e subterrâneas deverão ser expressos em escala equivalente àquela indicada nos valores máximos permitidos pela legislação, ou seja, a Resolução CONAMA nº 357/2005 e Portaria nº 36 de 19/01/90 do Ministério da Saúde, para possibilitar eventuais confrontações. Deverão ser também apresentados com a indicação das metodologias empregadas.
6. Deverá ser mantida anualmente até 31 de janeiro do ano subsequente, a apresentação do relatório compreendendo a tabulação dos resultados das monitorações realizadas e quantidade de resíduos recebida no ano anterior, juntamente com as correlações dos dados de pluviometria e de geração de líquidos percolados.

OBSERVAÇÕES:

1. A presente licença refere-se a implantação da Etapa 1 do aterro para codisposição de resíduos sólidos domiciliares e industriais classe II e III, para a área de atividade ao ar livre de 15.615,00m².

SELO DE AUTENTICIDADE

CETESB COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

Engº MAURO KAZUO SATO
Gerente da Agência
Ambiental de Santana
Reg. 01.2505-4 CREA 67.719/D

AUTENTICAÇÃO
16 SET 2005

Colégio Notarial do Brasil - SP
AUTENTICAÇÃO
0673AC075210

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ENTIDADE

Pág. 2

Figure 11 - CDR Pedreira Operational License (page 2 of 2)

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 EPLGP will not have significant environmental impacts. The infra-structure to collect and flare the gas will not likely generate significant impacts at the site.

The CDR Pedreira landfill is one of the few landfills that has the Environmental License from CETESB. It can be stated that CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. is totally committed with the environmental integrity in its practices.

Flaring gas, nevertheless may cause gaseous emissions, such as volatile organic compounds and dioxins that need to be controlled. During the environmental licensing procedures, all the necessary measurements will be made in order to mitigate such impacts, as requested for the issuance of the Operational License by CETESB.

SECTION E. Stakeholders' comments

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

As required by the Interministerial Commission on Global Climate Change, the Brazilian DNA, invitations must be sent for comments to local stakeholders as part of the procedures for analyzing CDM projects and issuing letters of approval. This procedure was followed by CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA. To take its GHG mitigation initiative to the public. Letters and the Executive Summary of the project were sent to the following recipients:

- Prefeitura Municipal de São Paulo – SP / *Municipal Administration of São Paulo – SP*.
- Secretaria do Verde e Meio Ambiente/ *Municipal Secreteriat of Environment of São Paulo – SP*.
- Câmara Municipal de São Paulo – SP / *Municipal Legislation Chamber of São Paulo –SP;*
- Ministério Público Estadual / *State Prosecutor's Office ;*
- Fórum Brasileiro de ONGs / *Brazilian NGO Forum ;*
- CETESB – Companhia de Tecnologia de Saneamento Ambiental / *Environmental Agency of the State of São Paulo;*
- Secretaria de Estado do Meio Ambiente */ Environment Secretary of State;*
- Rotary Clube de São Paulo - SP / *Rotary Club of São Paulo – SP*.

E.2. Summary of the comments received:

A comment from *Secretaria de Estado do Meio Ambiente* was received. According with the comment, project with landfill gas recovery are useful and present a lot of benefits. However, the project must be in accordance with the local legislation. Also, the material sent does not mention the quantitative of NOx emitted, the CERs produced and a future production of electricity or thermal energy, which could increase the benefits related to the baseline scenario.

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

CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA appreciated the comment from *Secretaria de Estado do Meio Ambiente* and argued that the material sent for analysis is only an idea of the project and its benefits related to the global warming. The amount of CERs equivalent can be found in the PDD, which stayed in GSC process from 20 June 2006 to 19 July 2006. As the GSC version is preliminary and future recommendation could be made during the validation process, CDR Pedreira –

CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA did not present the estimative and decided to wait until the final version, approved by the Brazilian DNA and submitted for registration to the EB.

About the energetic use of the landfill gas, CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA informs that has been studding different ways to use the gas, as these alternatives have been widely applied in the US and in Europe. However, at this moment the estimative of landfill gas generation are not favourable, once the landfill started its operations only in 2001 and as most of the equipment produced are not economically interesting as are produced in Europe and in the US. Thus, any calculation made at this moment to estimate the production of landfill gas in the future might not reflects the reality as the landfill might receive more or less waste than the estimated and, consequently, produce more or less gas than the estimated.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant -1:

Organization:	CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA.
Street/P.O.Box:	Av. Presidente Juscelino Kubitschek, n.º 1.830
Building:	Torre IV, 4º andar, sala 11
City:	São Paulo
State/Region:	SP
Postfix/ZIP:	04543-900
Country:	Brazil
Telephone:	+55 11 3706 8833
FAX:	+55 11 3078 3355
E-Mail:	alex@estre.com.br
URL:	http://www.estre.com.br
Represented by:	Alex Schlosser
Title:	Mr.
Salutation:	
Last Name:	Schlosser
Middle Name:	
First Name:	Alex
Department:	Environmental Manager
Mobile:	+ 55 11 7713 8562
Direct FAX:	+55 11 3078 3355
Direct tel:	+ 55 11 3076 8877
Personal E-Mail:	alex@estre.com.br

Project Participant -2:

Organization:	Econergy Brasil Ltda.
Street/P.O.Box:	Av. Angélica, 2530, cj. 111
Building:	Edifício Reynaldo Raucci
City:	São Paulo
State/Region:	SP
Postfix/ZIP:	01228-200
Country:	Brazil
Telephone:	+ 55 (11) 3555-5700
FAX:	+ 55 (11) 3555-5735
E-Mail:	-
URL:	http://www.econergy.com.br
Represented by:	Mrs. Francesca Maria Cerchia
Title:	Mrs.
Salutation:	
Last Name:	Cerchia
Middle Name:	
First Name:	Francesca Maria
Department:	-
Mobile:	+ 55 (11) 8584-2228
Direct FAX:	+ 55 (11) 3555-5735
Direct tel:	+ 55 (11) 3555-5700
Personal E-Mail:	cerchia@econergy.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in EPLGP.

Annex 3

BASELINE INFORMATION

Table 3. Baseline determination information

DATA	VALUE	UNIT	SOURCE
L_0 (methane potential generation)	0,06	m^3_{CH4}/kg_{waste}	USEPA[5]
k (decay constant)	0,1	1/year	
Year of opening	2001		CDR Pedreira
Year of closure	2020		
R_x	Variable	kg_{waste}	
EAF (Emission Adjustment Factor)	20	%	Estimated
CE	65	%	USEPA
FE	90	%	Flare Enclosed

USEPA (1996) suggest values of *k* and L_0 to be applied to the model. Because of the uncertainty in estimating L_0, gas flow estimates derived from the model should also be bracketed by a range of plus or minus 50 percent. To make a conservativeness approach, L_0 was assumed to be minus 50% of the lowest value of the range (2,25-2,88 ft^3/lb). Converting the units to m^3_{CH4}/kg_{waste}, the value assumed for L_0 is 0,07. To be more conservative, as the CDR Pedreira landfill receives different type of waste, a value of 0,06 to the ex-ante estimative was adopted.

The value of k was estimated as 0,1/year, the lowest of the suggested value, considering a wet climate.

The data of annual waste disposal was give by CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA., from 2001 to 2005. Data from 2006 on were estimated by CDR Pedreira – CENTRO DE DISPOSIÇÃO DE RESÍDUOS LTDA.

Project Emissions due to electricity purchased were estimated through approved methodology ACM0002 – Consolidated methodology for grid-connected electricity generation from renewable sources – version 6. In order to gather the daily dispatch data, which allows for the application of option *b)* Simple adjusted OM, the manager of the electricity system (ONS) was consulted in order to provide the data.

ACM0002 considers the determination of the emissions factor for the grid to which the project activity is connected as the core data to be determined in the baseline scenario. In Brazil, there are two main grids, South-Southeast-Midwest and North-Northeast, therefore the South-Southeast-Midwest Grid is the relevant one for this project.

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[5] USEPA – United States Environmental Agency; *Turning a Liability into an Asset: a Landfill Gas-to- Energy Project Development Handbook*; LMOP – Landfill Methane Outreach Program, 1996

The method that will be chosen to calculate the Operating Margin (OM) for the electricity baseline emission factor is the option (b) *Simple Adjusted OM*, since the preferable choice (c) *Dispatch Data Analysis OM* would face the barrier of data availability in Brazil.

In order to calculate the Operating Margin, daily dispatch data from the Brazilian electricity system manager (ONS) needed to be gathered. ONS does not regularly provide such information, which implied in getting it through communicating directly with the entity.

Simple Adjusted Operating Margin Emission Factor Calculation

According to the methodology, the project is to determine the Simple Adjusted OM Emission Factor ($EF_{OM,\ simple\ adjusted,\ y}$). Therefore, the following equation is to be solved:

$$EF_{OM,simple\_adjusted,y} = (1-\lambda_y)\frac{\sum_{i,j} F_{i,j,y}.COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (tCO_2e/GWh)$$

It is assumed here that all the low-cost/must-run plants produce zero net emissions.

$$\frac{\sum_{i,k} F_{i,k,y}.COEF_{i,k}}{\sum_k GEN_{k,y}} = 0 \quad (tCO_2e/GWh)$$

Please refer to the methodology text or the explanations on the variables mentioned above.

The ONS data as well as the spreadsheet data with the calculation of emission factors have been provided to the validator (DOE). In the spreadsheet, the dispatch data is treated as to allow calculation of the emission factor for the most three recent years with available information, which are 2003, 2004 and 2005.

The Lambda factors were calculated in accordance with methodology requests. The table below presents such factors.

Year	Lambda
2003	0,5312
2004	0,5055
2005	0,5130

Electricity generation for each year needs also to be taken into account. This information is provided in the table below.

Year	Electricity Load (MWh)
2003	288.933.290
2004	302.906.198
2005	314.533.592

Using therefore appropriate information for $F_{i,j,y}$ and $COEF_{i,j}$, OM emission factors for each year can be determined, as follows.

$$EF_{OM,simple\_adjusted,2003} = (1-\lambda_{2003})\frac{\sum_{i,j} F_{i,j,2003}.COEF_{i,j}}{\sum_{j} GEN_{j,2003}} \therefore EF_{OM,simple\_adjusted,2003} = 0{,}4605 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2004} = (1-\lambda_{2004})\frac{\sum_{i,j} F_{i,j,2004}.COEF_{i,j}}{\sum_{j} GEN_{j,2004}} \therefore EF_{OM,simple\_adjusted,2004} = 0{,}4531 \text{ tCO}_2\text{/MWh}$$

$$EF_{OM,simple\_adjusted,2005} = (1-\lambda_{2005})\frac{\sum_{i,j} F_{i,j,2005}.COEF_{i,j}}{\sum_{j} GEN_{j,2005}} \therefore EF_{OM,simple\_adjusted,2005} = 0{,}3937 \text{ tCO}_2\text{/MWh}$$

Finally, to determine the baseline *ex-ante*, the full generation weighted-average among the three years is calculated, finally determining the $EF_{OM,simple\_adjusted}$.

$$EF_{OM,simple\_adjusted\,2003\_2005} = \frac{EF_{OM,simple\_adjusted,2003} * \sum_j GEN_{j,2003} + EF_{OM,simple\_adjusted,2004} * \sum_j GEN_{j,2004} + EF_{OM,simple\_adjusted,2005} * \sum_j GEN_{j,2005}}{\sum_j GEN_{j,2003} + \sum_j GEN_{j,2004} + \sum_j GEN_{j,2005}} = 0{,}4349$$

According to the methodology used, a Build Margin emission factor also needs to be determined.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y}.COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

Electricity generation in this case means 20% of total generation in the most recent year (2005), as the 5 most recent plants built generate less than such 20%. If 20% falls on part capacity of a plant, that plant is fully included in the calculation. Calculating such factor one reaches:

$$EF_{BM,2005} = 0{,}0872 \text{ tCO}_2\text{/MWh}$$

Finally, the electricity baseline emission factor is calculated through a weighted-average formula, considering both the OM and the BM, being the weights 50% and 50% by default. That gives:

$$EF_{electricity,2003-2005} = 0{,}5 * 0{,}4349 + 0{,}5 * 0{,}0872 = 0{,}2611 \text{ tCO}_2\text{/MWh}$$

The Brazilian electricity system has been historically divided into two subsystems: the North-Northeast (N-NE) and the South-Southeast-Midwest (S-SE-CO). This is due mainly to the historical evolution of the physical system, which was naturally developed nearby the biggest consuming centers of the country.

The natural evolution of both systems continues to demonstrate that integration will happen in the future. In 1998, the Brazilian government announced the first leg of the interconnection line between S-SE-CO and N-NE. With investments of around US$700 million, the connection had the main purpose, in the government's view, at least, to help solve energy imbalances in the country: the S-SE-CO region could supply the N-NE in case it was necessary and vice-versa.

Nevertheless, even after the interconnection was established, technical papers continue to divide the Brazilian system in three (Bosi, 2000)[6]:

"… where the Brazilian Electricity System is divided into three separate subsystems:

(i) The South/Southeast/Midwest Interconnected System;
(ii) The North/Northeast Interconnected System; and
(iii) The Isolated Systems (which represent 300 locations that are electrically isolated from the interconnected systems)"

Moreover, the ACM0002 version 6 suggests using the regional grid definition, in large countries with layered dispatch systems (e.g. state/provincial/regional/national), where DNA guidance is not available. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity;

Finally, one has to take into account that even though the systems today are connected, the energy flow between N-NE and S-SE-CO is heavily limited by the transmission lines capacity. Therefore, only a fraction of the total energy generated in both subsystems is sent one way or another. It is natural that this fraction may change its direction and magnitude (up to the transmission line's capacity) depending on the hydrological patterns, climate and other uncontrolled factors. But it is not supposed to represent a significant amount of each subsystem's electricity demand.

The Brazilian electricity system nowadays comprises of around 101,3 GW of installed capacity, in a total of 1.482 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 4,5% are diesel and fuel oil plants, 3,2% are biomass sources (sugarcane bagasse, black liquor, wood, rice straw and biogas), 2% are nuclear plants, 1,4% are coal plants, and there are also 8,17 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid[7]. This latter capacity is in fact comprised by mainly 5,65 GW of the Paraguayan part of *Itaipu Bi-national*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

The approved methodology ACM0002 asks project proponents to account for "all generating sources serving the system". In that way, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

However, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – National System Operator – 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 specifically contacted and the reason for data collection was explained. After several months of talks, plants' daily dispatch information was made available by ONS.

Project proponents, discussing the feasibility of using such data, concluded it was the most proper information to be considered when determining the emission factor for the Brazilian grid. According to

[6] Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study.* International Energy Agency. Paris, 2000.
[7] www.aneel.gov.br

ANEEL, in fact, ONS centralized dispatched plants accounted for 75.547 MW of installed capacity by 31/12/2004, out of the total 98.848,5 MW installed in Brazil by the same date[8], which includes capacity available in neighboring countries to export to Brazil and emergency plants, that are dispatched only during times of electricity constraints in the system. Such capacity in fact is constituted by plants with 30 MW installed capacity or above, connected to the system through 138kV power lines, or at higher voltages. Therefore, even though the emission factor calculation is carried out without considering all generating sources serving the system, about 76,4% of the installed capacity serving Brazil is taken into account, which is a fair amount if one looks at the difficulty in getting dispatch information in Brazil. Moreover, the remaining 23,6% are plants that do not have their dispatch coordinated by ONS, since: either they operate based on power purchase agreements which are not under control of the dispatch authority; or they are located in non-interconnected systems to which ONS has no access. In that way, this portion is not likely to be affected by the CDM projects, and this is another reason for not taking them into account when determining the emission factor.

In an attempt to include all generating sources, project developers considered the option to research for available, but non-official data, to supply the existing gap. The solution found was the International Energy Agency database built when carrying out the study “Road-Testing Baselines For Greenhouse Gas Mitigation Projects in the Electric Power Sector”, published in October 2002. Merging ONS data with the IEA data in a spreadsheet, project proponents have been able to consider all generating sources connected to the relevant grids in order to determine the emission factor. The emission factor calculated was found more conservative when considering ONS data only, as the table below shows the build margin in both cases.

IEA/ONS Merged Data Build Margin (tCO_2/MWh)	**ONS Data Build Margin (tCO_2/MWh)**
0,205	0,0872

Therefore, considering all the rationale explained, the project developers selected to use ONS information only, as it was capable of properly addressing the issue of determining the emission factor and doing it in the most conservative way.

The fossil fueled plants efficiencies were also taken from the IEA paper. This was done considering the lack of more detailed information on such efficiencies from public, reliable and credible sources.

From the mentioned reference:

> *“The fossil fuel conversion efficiency (%) for the thermal power plants was calculated based on the installed capacity of each plant and the electricity actually produced. For most of the fossil fuel power plants under construction, a constant value of 30% was used as an estimate for their fossil fuel conversion efficiencies. This assumption was based on data available in the literature and based on the observation of the actual situation of those kinds of plants currently in operation in Brazil. The only 2 natural gas plants in combined cycle (totaling 648 MW) were assumed to have a higher efficiency rate, i.e. 45%.”*

Therefore only data for plants under construction in 2005 (with operation start in 2003, 2004 and 2005) was estimated. All others efficiencies were calculated. To the best of our knowledge there was no retrofit/modernization of the older fossil-fuelled power plants in the analyzed period (2003 to 2005). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

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[8] www.aneel.gov.br/arquivos/PDF/Resumo_Gráficos_mai_2005.pdf

The aggregated hourly dispatch data received from ONS was used to determine the lambda factor for each of the years with available data (2003, 2004 and 2005). The Low-cost/Must-run generation was determined as the total generation minus the generation from fossil-fuelled thermal plants generation. All this information has been provided to the validators, and extensively discussed with them, in order to make all points crystal clear.

On the following pages, a summary of the analysis is provided. The Table 5 shows the summarized conclusions of the analysis of the emission factor calculation and Figures 13, 14 and 15 present the load duration curves for the S-SE-CO subsystem. Finally, the Figure 16 shows the estimated generation of methane in the baseline scenario and the methane captured and fired.

Table 4. Emission factors for the Brazilian South-Southeast-Midwest Subsystem

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	**EF_{OM} [tCO2/MWh]**	**Load [MWh]**	**LCMR [MWh]**	**Imports [MWh]**
2003	0,9823	288.933.290	274.670.644	459.586
2004	0,9163	302.906.198	284.748.295	1.468.275
2005	0,8086	314.533.592	296.690.687	3.535.252
	Total (2003-2005) =	**906.373.081**	**856.109.626**	**5.463.113**
	$EF_{OM, simple-adjusted}$ [tCO2/MWh]	**$EF_{BM,2005}$**	**Lambda**	
	0,4349	0,0872	λ_{2003}	
	Weights	**Default weights**	0,5312	
	w_{OM} = 0,50	w_{OM} = 0,5	λ_{2004}	
	w_{BM} = 0,50	w_{BM} = 0,5	0,5055	
	EF_y [tCO2/MWh]	**Default EF_y [tCO2/MWh]**	λ_{2005}	
	0,2611	0,2611	0,5130	

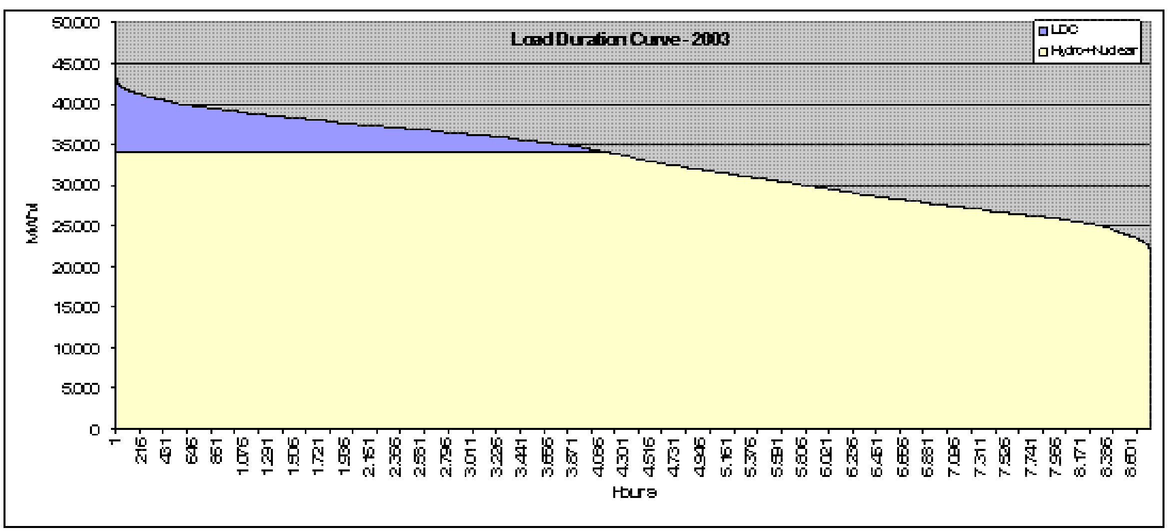

Figure 12. Load duration curve for the S-SE-CO subsystem, 2003

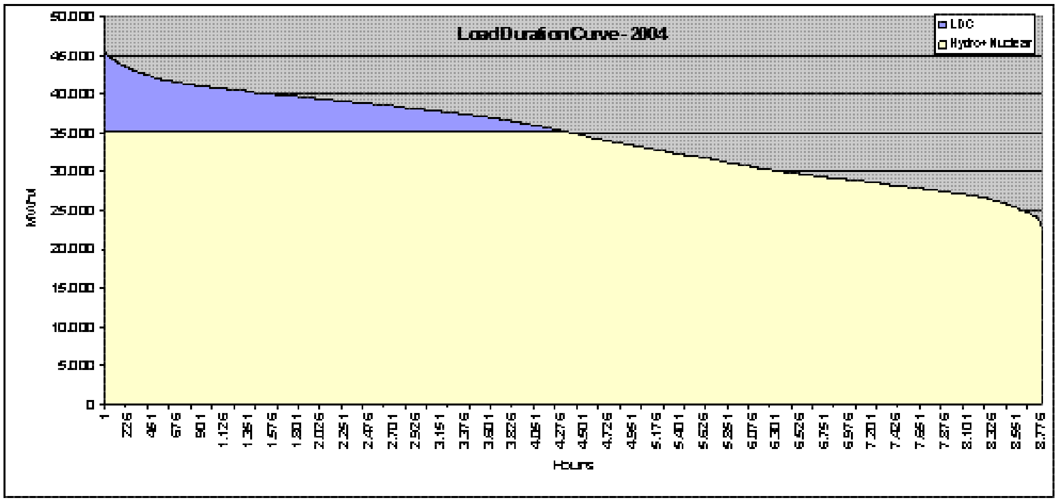

Figure 13. Load duration curve for the S-SE-CO subsystem, 2004

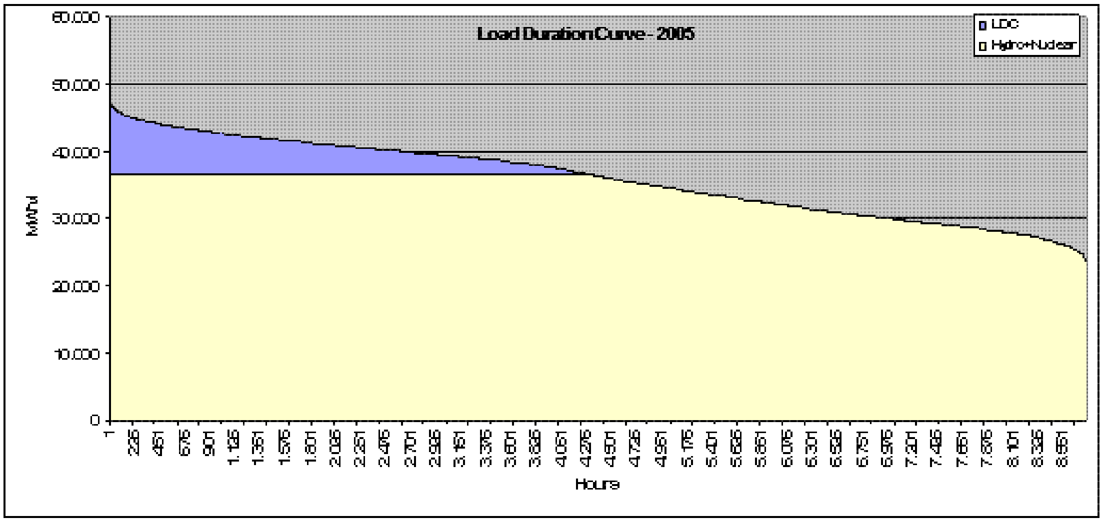

Figure 14. Load duration curve for the S-SE-CO subsystem, 2005

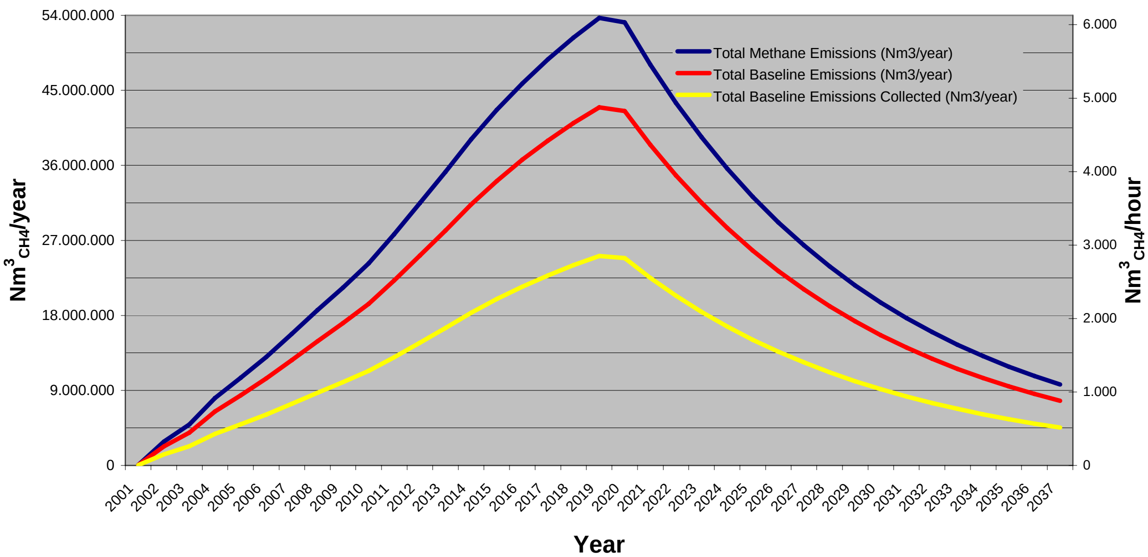

Figure 15. Methane estimative for EPLGP

Annex 4

MONITORING INFORMATION

The calculation of emission reductions will be made using the following table:

A	The lowest value between "Total LFG collected" and "LFG sent to flares"	m^3
B	Methane content on LFG	$\%_{methane}$
C	Pressure of the LFG	bar
D	Temperature of the LFG	K
E = $B \times \frac{C \times A}{D} \times \frac{273}{1.013} \times 0.0007168$	Methane collected	$t_{methane}$
F	Flare Efficiency	%
G = E . F	Total methane destroyed	$t_{methane}$
H = G . 21	Total CO_2e destroyed	tCO_2e
I = H . 0.1	Total CO_2e destroyed in the baseline	tCO_2e
J = H – I	CO_2e destroyed by EPLGP	tCO_2e
K	Total electricity imported	MWh
L	Emission factor of the grid which EPLGP is connected	tCO_2e/MWh
M = K . L	Emissions due to the import of electricity	tCO_2e
N = J – M	Emissions reductions due to EPLGP	tCO_2e

The calibration procedures will be made according with the fabricant's information.

As the project has not been implemented, no management structure and no procedures were identified. By the time of the project's implementation, all structures, authorities and procedures will be described and available to the Verification Team.

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