



**CLEAN DEVELOPMENT MECHANISM  
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)  
Version 02 - in effect as of: 1 July 2004)**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)

Version 2

Date of the document: 05/04/2006

**A.2. Description of the project activity:**

The CRRLGP aim is to capture and flare the landfill gas produced at Central de Resíduos do Recreio, landfill owned by SIL and located in Minas do Leão – Rio Grande do Sul, to avoid emissions of methane to the atmosphere.

Started operations in October 2001, CR do Recreio was designed to be the most complete structure for treatment and waste disposal in Rio Grande do Sul, using a finished coal mine as a landfill. With an area of 253.500 m<sup>2</sup> and capacity to receive 4,18 million tons of waste, the landfill already counts with more than one hundreds clients. Vast majority of these clients are municipalities. CR do Recreio fulfills local demand with alternatives for both household and industrial waste treatment.

CR do Recreio 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 SIL 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. 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.

CR do Recreio applies modern technologies on solid waste final disposal. Through the application of NBR 8419/92 – “Apresentação de projetos de aterros sanitários de resíduos sólidos urbanos” (a technical standard to develop and operate landfills while respecting environmental, health and engineering concerns), the landfill obeys to the following requirements:

- Proofing of the landfill basis with both compacted clay barriers and with a polyethylene geomembrane;
- Compacting of the solid waste with specific equipment;
- Covering of the compacted solid waste with clay, to avoid the dispersion of odor and the appearance of rats, cockroaches, buzzards and bugs;
- Controlling of the amount of solid waste disposed at the landfill;
- Collection and treatment of leachate;
- Release of landfill gas to the atmosphere, to avoid internal increase of pressure;
- Monitoring of the subterraneous water quality.

Respecting current environmental legislation and good practices for landfill projects, construction and operation, CR do Recreio received, in 2001, the Operational License from FEPAM – Fundação Estadual de Proteção Ambiental (Rio Grande do Sul Environmental Agency) and is one of the few landfills in Rio Grande do Sul that has complied with all the environmental requirements.



CRRLGP 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 CR do Recreio'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.

### **A.3. Project participants:**

<b>Name of Party involved (*) ((host) indicates a host Party)</b>	<b>Private and/or public entity (ies) project participants (*) (as applicable)</b>	<b>Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)</b>
Brazil (host)	• Brazilian Private entity SIL – Soluções Ambientais 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.		

CRRLGP participant is a Brazilian private entity called SIL – Soluções Ambientais. Hence, there will only be one Party to the project.

SIL – Soluções Ambientais is a 100% Brazilian company, founded in 1999 whose core business is in sanitation, waste treatment and final disposal. SIL brought to Brazil various success experiences. The company provides adequate solutions for final destination of the waste class II and III<sup>1</sup>, and is currently analyzing the availability of disposing of the waste class I.

SIL receives urban solid waste from more than 100 municipalities in Rio Grande do Sul, including from the capital Porto Alegre. Having the goal of adequate disposal of industrial and municipal waste, SIL is a leading company in Rio Grande do Sul sanitation sector.

### **A.4. Technical description of the project activity:**

#### **A.4.1. Location of the project activity:**

CR do Recreio (SIL's landfill) is located in the city of Minas do Leão, at about 80 km west of Porto Alegre, the capital of Rio Grande do Sul.

<sup>1</sup> Residues in Brazil are classified under norm NBR 10004, issued in 1987, from ABNT, the Brazilian association for technical standards. 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 reactive, neither classified as class I nor class III, and may present the following characteristics: combustibility, biodegradability or water solubility. Class III residues are non-reactive, not presenting any soluble constituent in standard higher than potable water.

**A.4.1.1. Host Party (ies):**

Brazil

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

Rio Grande do Sul

**A.4.1.3. City/Town/Community etc:**

Minas do Leão

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

Figure 1 shows the location of Minas do Leão.

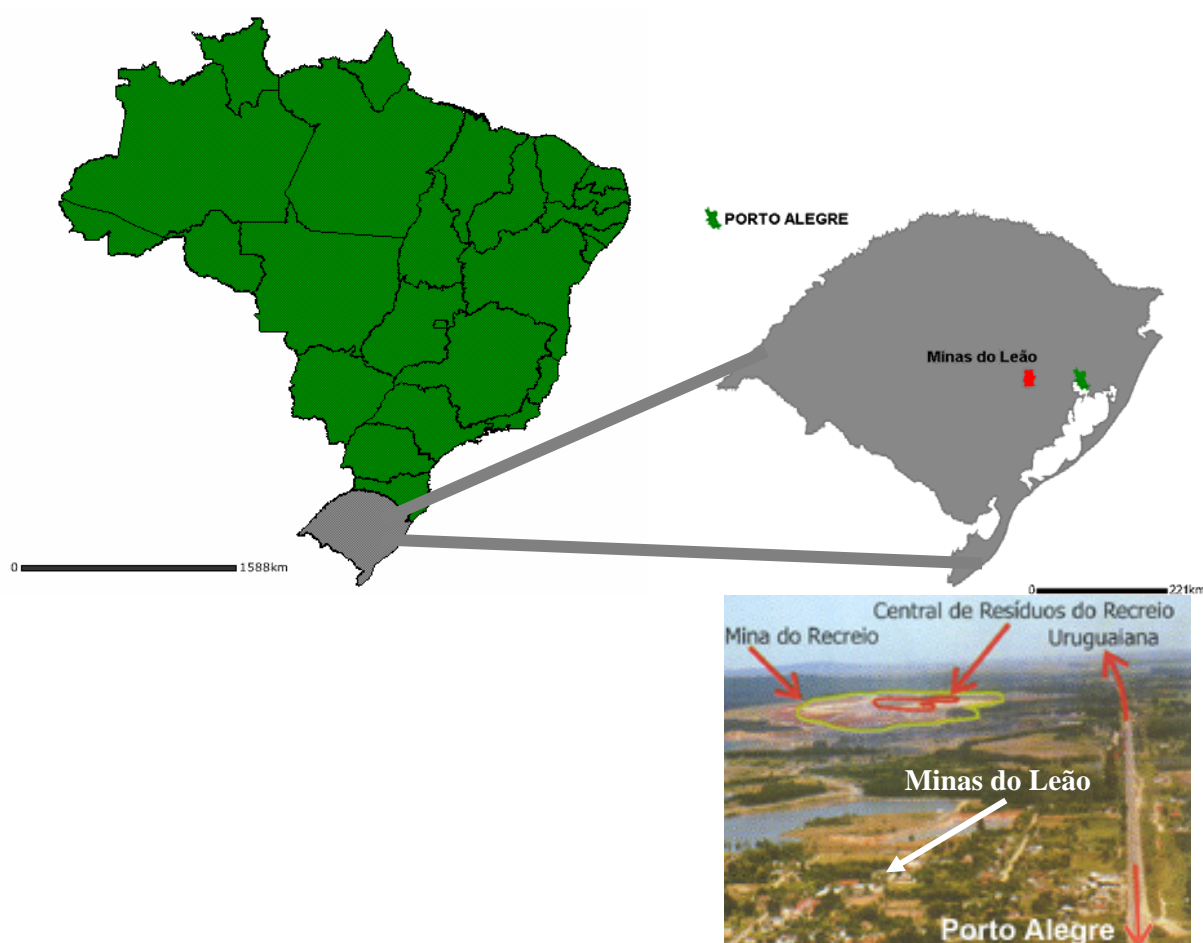


Figure 1. Minas do Leão location (Source: IBGE<sup>2</sup>)

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

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

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

**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 2.

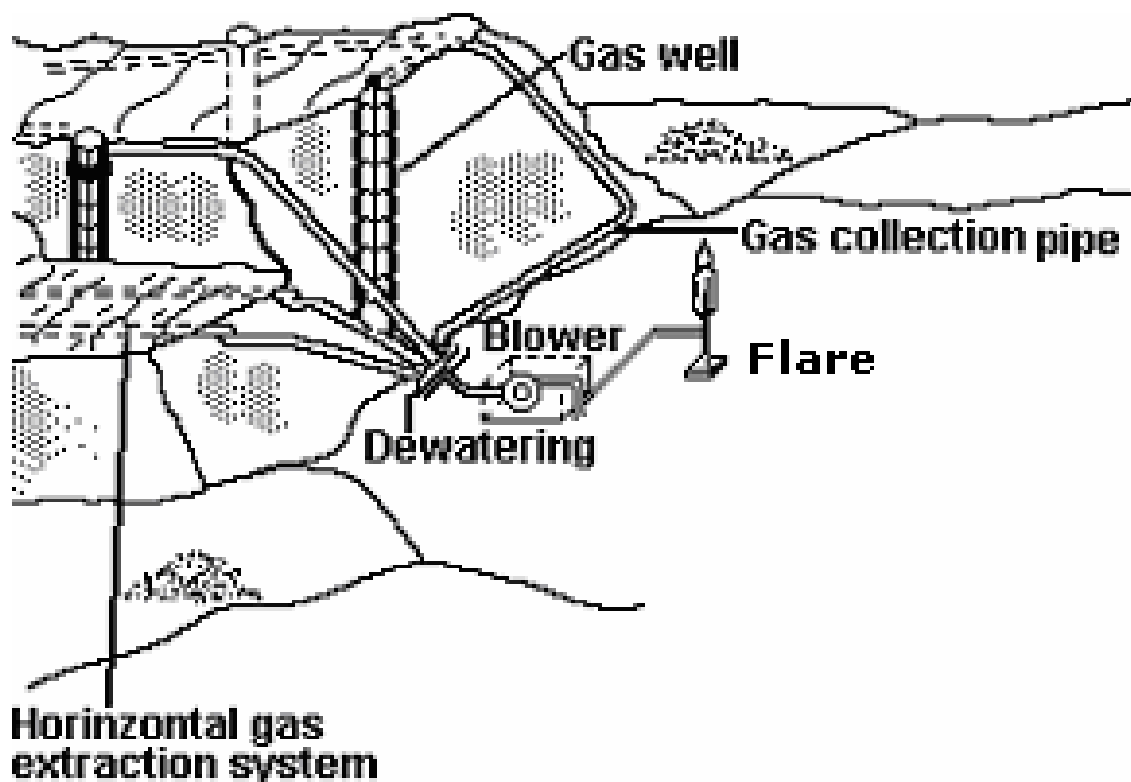


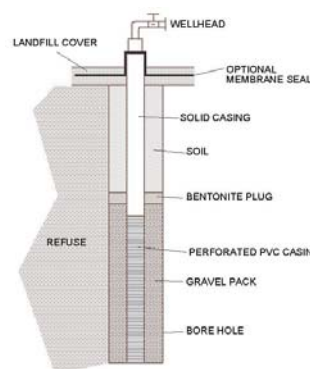
Figure 2. Schematic situation of a landfill with active gas recovery (Source: WILHELM, 1991<sup>3</sup>.)

Following concrete examples from other landfill gas projects in the world, the CRRLGP 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 3 and Figure 4.

<sup>3</sup> V. WILHELM; *Safety Aspects of the Planning, Construction and Operation of Landfill Gas Plants*; paper; Sardinia 91 Third International Landfill Symposium; S. Margherita di Pula, Cagliari, Italy; 14 - 18 October 1991



**Figure 3. Example of wellhead (source: Biogás Ambiental<sup>4</sup>)**



**Figure 4. 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.

A common practice all over the world is to use PVC equipment. It has the 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 5. 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.

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<sup>4</sup> Biogás Ambiental; available at < <http://www.biogas-ambiental.com.br/instalacao.html>>; accessed on Jan 31<sup>st</sup>, 2006.



Figure 6. 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 7. 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, SIL will need engineers and other specialists with experience in this area to advise 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 SIL to comply with its environmental guidelines.

**A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the**



**emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:**

The project activity will burn all the landfill gas collected in a flare, through the monitoring of the amount of methane burned.

The current practice in CR do Recreio, as explained in A.4.3, is passive venting. With CRRLGP's new facilities, it will be possible to efficiently flare the landfill gas. Accordingly, the methane that was previously released to the atmosphere, will be flared and reduced to CO<sub>2</sub>. Global warming will also be reduced since methane is 21 times more powerful than carbon dioxide.

Emission reductions would not occur in the absence of the CRRLGP because the improvement of the landfill is not mandated by law and is not an economically attractive investment.

Emission reductions from the first crediting period are expected to be **755 189 tCO<sub>2</sub>e**.

**A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:**

YEARS	ANNUAL ESTIMATION OF EMISSION REDUCTIONS IN TONNES OF CO <sub>2</sub> E
2007	71 987
2008	86 534
2009	100 117
2010	112 828
2011	124 750
2012	135 995
2013	122 978
<b>TOTAL ESTIMATED REDUCTIONS (TONNES OF CO<sub>2</sub>E)</b>	<b>755 189</b>
<b>TOTAL NUMBER OF CREDITING YEARS</b>	<b>7</b>
<b>ANNUAL AVERAGE OVER THE CREDITING PERIOD OF ESTIMATED REDUCTIONS (TONNES OF CO<sub>2</sub>E)</b>	<b>107 884</b>

**A.4.5. Public funding of the project activity:**

There is no public funding involved in this project activity.

## **SECTION B. Application of a baseline methodology**

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

The baseline methodology applied to CRRLGP is ACM0001, version 2, called "Consolidated baseline methodology for landfill gas project activities"

**B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:**





This methodology is applicable to the CRRLGP 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.2. Description of how the methodology is applied in the context of the project activity:**

With the implementation of the CRRLGP, methane that would be naturally released to the atmosphere in the baseline scenario will be captured through the use of a collecting and flaring system. Only a part of the methane is flared at the baseline due to safety and odor concerns.

As mentioned in A.4.3, a complete collecting network pipeline and a flaring system will be installed in order to avoid the emission of methane to the atmosphere. Such a system ensures that methane will be captured, transported and flared under controlled conditions, in a way that it will be possible to measure the amount of methane flared on-site.

As the CRRLGP does not produce electricity, 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 ( $GWP_{CH_4}$ ), as follows:

$$ER_y = (MD_{project, y} - MD_{reg, y}) \times 21 - EC_y \times EF, \text{ where:}$$

$ER_y$  = emission reductions of the project activity in year y (tCO<sub>2</sub>e);

$MD_{project, y}$  = quantity of methane destroyed at year y (tCH<sub>4</sub>);

$MD_{reg, y}$  = methane that would have been destroyed during the year y in the absence of the project activity (tCH<sub>4</sub>);

$GWP_{CH_4}$  = Global Warming Potential of Methane (tCO<sub>2</sub>e/tCH<sub>4</sub>);

$EC$  = Electricity consumed by the blower, during year y (MWh);

$EF$  = Emission factor of the electricity grid, where the project is connected (tCO<sub>2</sub>e/MWh)

As the CRRLGP does not have any contractual obligations to burn methane,  $MD_{reg, y}$  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

$$ER_y = 0,8 \times MD_{project, y} \times 21 - EC_y \times EF$$

The methane destroyed by the project activity  $MD_{project, y}$  during year y is determined by monitoring 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 ( $m^3_{LFG}$ );

$w_{CH_4, y}$  = methane fraction of the landfill gas ( $m^3CH_4 / m^3_{LFG}$ );

$D_{CH_4}$  = methane density ( $tCH_4 / m^3CH_4$ );

$FE$  = flare efficiency (%);

The estimate of the amount of landfill gas produced during year  $y$  is shown in E.4. The data used to determine the baseline scenario is presented in Annex 3

**B.3. 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:**

**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 CRRLGP 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***

1. 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***

2. 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.

3. Not applicable.

4. Not applicable.

**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 1. 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<sup>5</sup>) – 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 to open dumps which are, in most of the cases, areas without any sort of proper infrastructure to avoid environmental hazards. Figure 8 shows the final destination of waste per municipality, according to PNSB 2000.

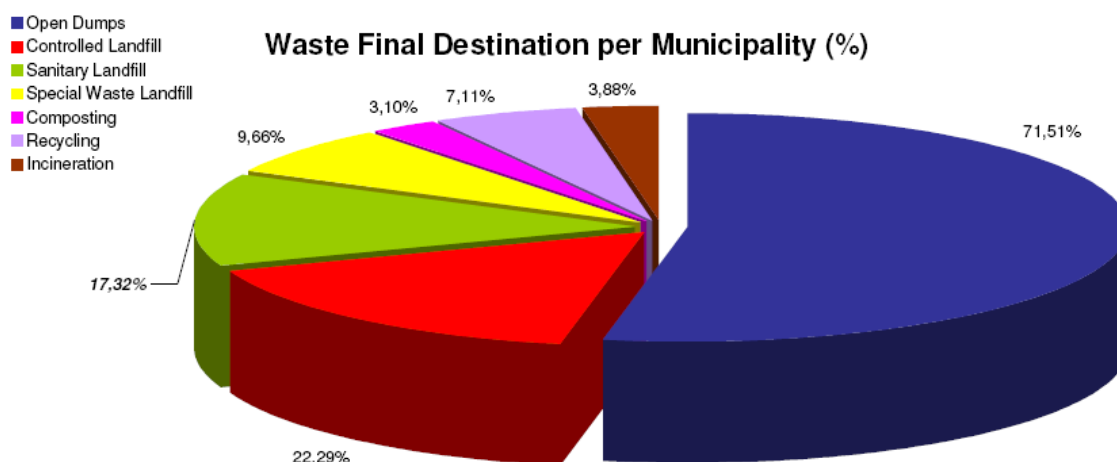


Figure 8. Waste Final Destination per Municipality in Brazil (Source: PNSB, 2000)

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.

<sup>5</sup> IBGE - Instituto Brasileiro de Geografia e Estatística. *Pesquisa Nacional de Saneamento Básico*, 2000.

**B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:**

The boundary is the project activity site, where the landfill operations and LFG emissions take place and where gas flaring will take place. Figure 4 provides a picture of the boundary:

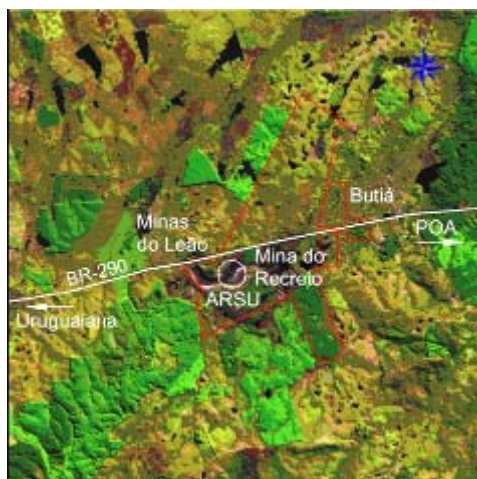


Figure 9. CRRLGP Boundary = ARSU

**B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:**

This baseline study was concluded on 24/02/2006, by Econergy, which is the *Project Developer*. Contact information:

Marcelo Schunn Diniz Junqueira  
[junqueira@econergy.com.br](mailto:junqueira@econergy.com.br)  
Tel: +55 (11) 3219 0068 ext 25  
Fax: +55 (11) 3219 0693  
[www.econergy.com.br](http://www.econergy.com.br)

**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:**

01/01/2007

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

21 years 0 months

**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:**

01/01/2007

**C.2.1.2. Length of the first crediting period:**

7 years 0 months

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

Not applicable

**C.2.2.2. Length:**

Not applicable

**SECTION D. Application of a monitoring methodology and plan****D.1. Name and reference of approved monitoring methodology applied to the project activity:**

The methodology applied to CRRLGP is AMC0001, version 2, called “Consolidated monitoring methodology for landfill gas project activities”.

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

This methodology is applicable to the CRRLGP 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. Moreover, the baseline methodology for the project is also ACM0001 – version 2, in accordance with the monitoring methodology. Therefore, ACM0001 – version 2 is fully applicable to CRRLGP.

**D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario****D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:**

ID number (Please use numbers to ease cross-referencing to D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

Not applicable

**D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)**

Not applicable

**D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :**

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

Not applicable

**D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)**

Not applicable

**D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).****D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:**

ID number (Please use numbers to ease cross-referencing to D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. LFG <sub>flare, y</sub>	Amount of landfill gas to flares	Flow meter	m <sup>3</sup>	m	Continuous	100%	Electronic and paper	Measured by a flow meter. Data will be aggregated monthly and yearly.
2. FE	Flare efficiency	Flare fabricant	%	m/c	(1) Continuous (2) quarterly, monthly if unstable	100%	Electronic and paper	(1) Periodic measurement of methane content of flare exhaust gas. (2) Continuous measurement of operation time of flare (e.g. with temperature)
3. w <sub>CH<sub>4</sub></sub> , y	Methane fraction in the landfill gas	Gas analyzer	m <sup>3</sup> <sub>CH<sub>4</sub></sub> /m <sup>3</sup> <sub>LFG</sub>	m	Continuous	100%	Electronic and paper	Measured by continuous gas quality analyzer.
4. T	Temperature of the landfill gas	Temperature sensor	°C	m	Continuous	100 %	Electronic and paper	Measured to determine the density of methane D <sub>CH<sub>4</sub></sub> .
5. p	Pressure of the landfill gas	Pressure sensor	kPa	m	Continuous	100%	Electronic and paper	Measured to determine the density of methane D <sub>CH<sub>4</sub></sub> .
6	Total amount of electricity and/or other energy carriers used in the project for gas	Hours of blower operation	MWh	m	Continuous	100%	Electronic and paper	Required to determine CO <sub>2</sub> emissions from use of electricity to operate the project activity.

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	pumping and heat transport							
7	CO <sub>2</sub> emission intensity of the electricity	Calculated	tCO <sub>2</sub> e/MWh	<i>c</i>	During the crediting period and two years after	0%	Electronic and paper	Required to determine CO <sub>2</sub> emissions from use of electricity to operate the project activity
8	Regulatory requirements relating to landfill gas projects				Annually	100%	Paper	Required for any changes to the adjustment factor (AF) or directly MD <sub>reg, y</sub> .

Obs: All data from the table above will be archived according to internal procedures, until 2 years after the end of the crediting period.

**D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.):**

$EF_{OM, simple\_adjusted, y} = (1 - \lambda_y) \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \text{ (tCO}_2\text{e/GWh)}$ $EF_{BM} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_m GEN_{m,y}} \text{ (tCO}_2\text{e/GWh)}$ $EF_{electricity} = \frac{EF_{OM} + EF_{BM}}{2} \text{ (tCO}_2\text{e/GWh)}$ $EP_y = EC_y \cdot EF$	<p><math>F_{i,j(or m),y}</math> Is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y</p> <p><math>j,m</math> Refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid</p> <p><math>COEF_{i,j(or m),y}</math> Is the CO<sub>2</sub> emission coefficient of fuel i (tCO<sub>2</sub> / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources j (or m) and the percent oxidation of the fuel in year(s) y, a</p> <p><math>GEN_{j(or m),y}</math> Is the electricity (MWh) delivered to the grid by source j (or m)</p> <p><math>EF_{electricity,y}</math> Is the CO<sub>2</sub> baseline emission factor for the electricity.</p> <p><math>PE_y</math> Are the project emissions during the year y in tons of CO<sub>2</sub>;</p> <p><math>EC_y</math> are the electricity consumed by the blower during the year y, in MWh</p>
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Obs: project emissions will be measured directly at the site.



**D.2.3. Treatment of leakage in the monitoring plan****D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

According with ACM0001, no leakage will be accounted for the project activity.

**D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)**

Left blank on purpose.

**D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO<sub>2</sub> equ.)**

(ER<sub>y</sub>) is the difference between the amount of methane actually destroyed/combusted during the year (MD<sub>project, y</sub>) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity (MD<sub>reg, y</sub>), times the approved Global Warming Potential value for methane (GWP<sub>CH4</sub>), as follows:

$$ER_y = (MD_{project, y} - MD_{reg, y}) \times GWP_{CH4} - EC_y \times EF, \text{ where:}$$

ER<sub>y</sub> = emission reductions of the project activity in year y (tCO<sub>2</sub>e);

MD<sub>project, y</sub> = quantity of methane destroyed at year y (tCH<sub>4</sub>);

MD<sub>reg, y</sub> = methane that would have been destroyed during the year y in the absence of the project activity (tCH<sub>4</sub>);

GWP<sub>CH4</sub> = Global Warming Potential of Methane (tCO<sub>2</sub>e/tCH<sub>4</sub>);

EC = Electricity consumed by the blower, during year y (MWh);

EF = Emission factor of the electricity grid, where the project is connected (tCO<sub>2</sub>e/MWh)



As CRRLGP does not have any contractual obligations to burn methane,  $MD_{reg,y}$  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

$$ER_y = 0,8 \times MD_{project,y} \times 21 - EC_y \times EF$$

The methane destroyed by the project activity  $MD_{project,y}$  during year y is determined by monitoring 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<sub>4</sub>);

$LFG_{flared,y}$  = quantity of landfill gas flared during the year (m<sup>3</sup><sub>LFG</sub>);

$w_{CH_4,y}$  = methane fraction of the landfill gas (m<sup>3</sup>CH<sub>4</sub>/ m<sup>3</sup><sub>LFG</sub>);

$D_{CH_4}$  = methane density (tCH<sub>4</sub>/m<sup>3</sup>CH<sub>4</sub>);

$FE$  = flare efficiency (%);

In other words,  $ER_y$  is equal to:

$$ER_y = (0,8 \times LFG_{flared,y} \times w_{CH_4} \times D_{CH_4} \times FE \times 21) - EC_y \times EF$$

### D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.



1. LFG <sub>flare, y</sub>	<i>Low</i>	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy
2. FE	<i>Medium</i>	Regular maintenance should ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
3. WCH <sub>4, y</sub>	<i>Low</i>	Gas analyzer should be subject to a regular maintenance and testing regime to ensure accuracy
4. T	<i>Low</i>	Temperature sensors should be subject to a regular maintenance and testing regime to ensure accuracy
5. p	<i>Low</i>	Pressure sensors should be subject to a regular maintenance and testing regime to ensure accuracy
6	<i>Low</i>	Direct measure from the blower's consumed electricity.

**D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity**

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.

**D.5 Name of person/entity determining the monitoring methodology:**

This monitoring study was concluded on 24/02/2006, by Econergy, which is the *Project Developer*. Contact information:

Marcelo Schunn Diniz Junqueira  
[junqueira@econergy.com.br](mailto:junqueira@econergy.com.br)  
 Tel: +55 (11) 3219 0068 ext 25  
 Fax: +55 (11) 3219 0693  
[www.econergy.com.br](http://www.econergy.com.br)

**SECTION E. Estimation of GHG emissions by sources****E.1. Estimate of GHG emissions by sources:**

The only source of GHG project emissions is the CO<sub>2</sub> emissions due to the import of electricity. It's calculated multiplying the grid's Emission Factor (EF) by the amount of electricity consumed, in MWh, as follows:

$$EP_y = EC_y \times FE, \text{ where:}$$

$EP_y$  = EF.EC<sub>y</sub> (tCO<sub>2</sub>), where:

$EP_y$  = emissions due to the consumption of electricity during year  $y$  (tCO<sub>2</sub>e);

$EF$  = emission factor of the electricity grid (tCO<sub>2</sub>e/MWh);

$EC_y$  = electricity consumed by the landfill gas blower, during year  $y$  (MWh).

As demonstrated on Annex 3, the EF for the Brazilian electric grid is equal to 0,2636 tCO<sub>2</sub>e/MWh. Assuming that the blower is estimated to need around 3,000 MWh/year. That gives an  $EP_y$  average of 790 tCO<sub>2</sub>e/year.

**E.2. Estimated leakage:**

According with ACM0001, no leakage effects need to be accounted under this methodology.

Thus,  $L_y = 0$ .

**E.3. The sum of E.1 and E.2 representing the project activity emissions:**

$$E.1 + E.2 = 0,2636 \times 3000 + 0 = 790 \text{ tCO}_2\text{e/year}$$

**E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:**

GHG emissions by sources in the baseline were estimated using IPCC's guidelines<sup>6</sup>. In the case of CRRLLGP, the derivative of first order decay model approach was used:

$$Q_{T,y} = \frac{k \times R_y \times L_0 \times \sum_{i=y}^T \sum_{j=y}^i [e^{-k(i-j)}]}{F}, \text{ where:}$$

- $Q_{T,y}$  = landfill gas produced during year  $T$  (m<sup>3</sup><sub>LFG</sub>);
- $k$  = decay constant (1/year);
- $R_y$  = amount of waste disposed on year  $y$  (kg);
- $L_0$  = methane potential generation (m<sup>3</sup><sub>CH<sub>4</sub></sub>/Mg<sub>waste</sub>);
- $T$  = actual year;
- $y$  = year of waste disposal;
- $F$  = fraction of methane at the landfill gas (%)

<sup>6</sup> Revised 1996 IPCC Guidelines for National Greenhouse Gases Inventory.



To summarize, relevant factors for landfill gas estimation are:

- Year the site opened
- Year the site closed
- Amount of waste disposed at the site in a given year
- Methane generation rate constant (k)
- Methane generation potential ( $L_0$ )

SIL provided waste flow data from year 2001 to year 2005 together with the estimative for 2006 through 2014. It has to be mentioned that SIL wants to expand the CR do Recreio's area and extend the landfill's lifetime for 16 more years (until 2030). The emission reductions estimative were calculated only considering the landfill's closure year on 2014.

For CRRLGP's estimative, a conservative collection efficiency value of 50% was considered. So,  $LFG_{flare, y}$  is equal to 50% of total landfill gas emitted to the atmosphere at the baseline:

In other words, the amount of Methane destroyed by the project activity is calculated as follows:

$$MD_{project, y} = 0,8 \times 0,5 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^T \sum_{j=y}^i [e^{-k(i-j)}]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21$$

or

$$MD_{project, y} = 0,4 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^T \sum_{j=y}^i [e^{-k(i-j)}]}{F} \times w_{CH_4} \times D_{CH_4} \times FE \times 21$$

Baseline emissions are **760.725 tCO<sub>2</sub>e** over the project's crediting period.

<b>E.5. Difference between E.4 and E.3 representing the emission reductions of the <u>project activity</u>:</b>
---

$$ER_y = \left( 0,4 \times \frac{k \times R_y \times L_0 \times \sum_{i=y}^T \sum_{j=y}^i [e^{-k(i-j)}]}{F} \right) \times w_{CH_4} \times D_{CH_4} \times FE \times 21 - EC_y \times EF$$

This equation has been used for estimation purposes only, as the real emission reductions will be measured at the project site following the monitoring methodology for CRRLGP.

Project emission reductions are estimated to be **755.189 tCO<sub>2</sub>e** over first 7 years crediting period.

**E.6. Table providing values obtained when applying formulae above:**

<b>Year</b>	<b>Estimation of project activity emission reductions (tonnes of CO<sub>2</sub>e)</b>	<b>Estimation of the baseline emission reductions (tonnes of CO<sub>2</sub>e)</b>	<b>Estimation of leakage (tonnes of CO<sub>2</sub>e)</b>	<b>Estimation of emission reductions (tonnes of CO<sub>2</sub>e)</b>
<b>2007</b>	790	72 777	0	71 974
<b>2008</b>	790	87 325	0	86 522
<b>2009</b>	790	100 908	0	100 105
<b>2010</b>	790	113 619	0	112 816
<b>2011</b>	790	125 541	0	124 738
<b>2012</b>	790	136 786	0	135 983
<b>2013</b>	790	123 769	0	122 966
<b>Total (tonnes of CO<sub>2</sub>e)</b>	<b>5 536</b>	<b>760 725</b>	<b>0</b>	<b>755 189</b>

Emission reductions from the first crediting period are expected to be, therefore, 755 189 tCO<sub>2</sub>e. Nevertheless, emission reductions will actually be measured directly at the project site.

**SECTION F. Environmental impacts****F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

The possible environmental impacts are to be analyzed by the FEPAM (Fundação Estadual de Proteção Ambiental) – Rio Grande do Sul environmental agency. SIL received the first Operating Licence for CR do Recreio on 18 September 2001, which was renewed twice (on 2002 and 2003), in order to obtain the Operational Licence 2495/2004 on 30 March 2004, valid until 14 June 2008, and will carry out the necessary process in order to obtain the Operational Licence for the CRRLGP's facilities. The CR do Recreio's Operation License from 2004 is shown in, Figure 10, Figure 11 and Figure 12.



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**LICENÇA DE OPERAÇÃO****LO N° 2495/2004-DL**

A Fundação Estadual de Proteção Ambiental, criada pela Lei Estadual n° 9.077 de 04/06/90 e com seus Estatutos aprovados através do Decreto n° 33.765, de 28/12/90, registrada no Ofício do Registro Oficial em 01/02/91, no uso das atribuições que lhe confere a Lei n° 6.938, de 31/08/81, que dispõe sobre a Política Nacional do Meio Ambiente, regulamentada pelo Decreto n° 99.274, de 06/06/90 e com base nos autos do processo administrativo n° 2368-05.67/04.5, expede a presente LICENÇA DE OPERAÇÃO que autoriza a:

**EMPREENDIMENTO:** 66536,**CODRAM:** 3542.20,**EMPREENDEDOR:** SIL SOLUÇÕES AMBIENTAIS LTDA.,**ENDEREÇO:** BR-290, km 181, s/n°, Bairro Coréia,**MUNICÍPIO:** Minas do Leão - RS,a promover a operação relativa

à atividade de: DESTINAÇÃO DE RESÍDUOS SÓLIDOS URBANOS, através de ATERRO SANITÁRIO (ARSU), parte integrante da CENTRAL DE RESÍDUOS DO RECREIO ( área de 400.000 m²),

localizada: na BR-290, km 178, Mina do Recreio, cava do bloco Coréia, coordenadas UTM 400.600 a 401.400E e 6.664.000 a 6.664.500N, no município de Minas do Leão - RS.

Com as condições e restrições:

01-esta licença renova a Licença de Operação n° 1897/2003-DL;

02-esta licença refere-se somente a operação do aterro sanitário de resíduos urbanos (ARSU, para resíduos domiciliares (Classe II) e resíduos caracterizados como Classe III (inertes), de conformidade com a NBR 10.004), e parte da Estação de Tratamento de Efluentes-EET, relativa ao tratamento biológico, da Central de Resíduos do Recreio;

03-o aterro de resíduos sólidos urbanos (ARSU) ocupará toda a cava disponível do bloco Coréia, com capacidade volumétrica de 5.537.100 m³ e área de 25,35 ha, para uma capacidade máxima prevista de 33.000 m³/mês, considerada uma vida útil de 14 anos, organizado sob a forma de níveis, e disposto em 11 níveis, com altura de 5m/nível;

04-a profundidade da cava (bloco Coréia) é de 51 metros, devendo esta, ser a altura máxima do aterro;

05-o efluente final do sistema de tratamento deverá ser conduzido ao reservatório que abastece o lavador de carvão, em operação na Mina do Recreio;

06-qualquer efluente que venha a ser gerado na área de disposição de resíduos, deverá atender aos padrões constantes da Norma Técnica 01/89-SSMA, antes de ser disposto no ambiente;

07-o recebimento dos resíduos na Central de Resíduos do Recreio (ARSU), fica condicionado a assinatura de contrato entre a SIL Soluções Ambientais Ltda. e os usuários, devendo constar no mesmo o prazo contratado, cuja cópia deverá ser enviada à FEPAM, pela SIL Soluções Ambientais Ltda., até 5 (cinco) dias após a assinatura do documento. No caso de rescisão contratual, deverá a SIL informar, por escrito, a FEPAM;

08-o controle do recebimento dos resíduos no aterro de resíduos sólidos urbanos (ARSU) é de responsabilidade do empreendedor, devendo ser observados os critérios de compatibilidade para o qual foi projetado;

09-os resíduos não compatíveis com os autorizados nesta licença deverão ser devolvidos ao gerador;

10-a SIL Soluções Ambientais Ltda deverá apresentar à FEPAM, **trimestralmente**, laudo técnico (com ART do responsável) de acompanhamento das condições operacionais do aterro (ARSU).

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Fundação Estadual de Proteção Ambiental Henrique Luís Roessler/RS

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**Figure 10. CR do Recreio's Operation License (page 1 of 3)**



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de conformidade com o apresentado no Manual de Operações, item 2.4.3, e informações relativas às evidências apuradas conforme item 11, desta licença, bem como as ações corretivas e preventivas a adotar, quando a situação assim o exigir:

11- o Boletim de Registro de Recebimento de Resíduos deverá ser enviado **mensalmente** à FEPAM

12- deverá ser observado o procedimento de adoção de frente de serviço mínima possível, com cobertura diária dos resíduos, de modo a garantir o manejo adequado dos mesmos;

13- o monitoramento ambiental de águas subterrâneas, nos pontos identificados como PZ-1P, PZ-3P, PZ-1A, PZ-3A, PZ-02, PZ-03 e SDP-1, deverá ser realizado **semestralmente**, para os parâmetros apresentados no Manual de Operação, Quadro 4.1, item 4.5, devendo os resultados e devida interpretação serem enviados à FEPAM;

14- o monitoramento ambiental para águas superficiais, nos pontos identificados como PR-4 e PR-5, no Arroio Taquara, deverá ser realizado **trimestralmente**, para os parâmetros apresentados no Manual de Operação, Quadro 4.1, item 4.5, devendo os resultados e devida interpretação serem enviados à FEPAM;

15- o monitoramento operacional para a ETE, nos pontos identificados como ST-1, ST-2, ST-3, ST-4 e ST-5 deverá ser realizado na frequência e parâmetros apresentados no Manual de Operação, Quadro 4.1, item 4.5, devendo os resultados e devida interpretação serem enviados à FEPAM;

16- deverá ser realizado o monitoramento diário, no entorno do aterro e em sua superfície, do sistema de controle de migração de gases, de modo a prevenir risco de explosão, adotando, no caso de detecção de falhas, as medidas previstas no Manual de Operação, item 4.4;

17- deverão ser observados procedimentos de inspeção e manutenção aos sistemas de drenagens de superfície, de lixiviados, de gases, de detecção de vazamentos e de monitoramento, iluminação, sinalização, acessos, processos erosivos, presença de vetores, e demais elementos e instalações implantadas;

18- em qualquer caso de derramamento, vazamento, deposição acidental de resíduos ou outro tipo de acidente, a FEPAM deverá ser comunicada imediatamente após o ocorrido, devendo ser apresentadas as medidas sancionadoras, explicitando as já adotadas, em cumprimento ao disposto no Art. 10 do Decreto Estadual nº 38.356, de 1º de Abril de 1998, que regulamenta a Lei Estadual nº 9921/93;

19- a qualquer tempo, por entendimento desta FEPAM, poderão ser fixadas novas condições e restrições à atividade em questão;

20- a concessão desta licença deverá ser publicada de acordo com a Resolução CONAMA Nº 006/86, em anexo.

**OBSERVAÇÃO IMPORTANTE:** o empreendedor é responsável por manter condições operacionais adequadas, respondendo por quaisquer danos ao meio ambiente decorrentes da má operação do empreendimento.

Com vistas à **RENOVAÇÃO DA LICENÇA DE OPERAÇÃO** o empreendedor deverá apresentar:

01- requerimento solicitando a renovação da Licença de Operação;

02- cópia desta licença;

03- cópia da publicação da concessão desta licença e da solicitação de sua renovação, de acordo com a Resolução CONAMA Nº 006/86;

04- declaração do empreendedor quanto à responsabilidade técnica pela operação do sistema, remetendo nova ART caso tenha sido alterado o responsável;

05- comprovante do pagamento dos custos dos Serviços de Licenciamento Ambiental conforme Resolução nº 01/95-CONS. ADM., publicada no DOE em 01/09/95

Fundação Estadual de Proteção Ambiental Henrique Luís Roessler/RS


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Figure 11. CR do Recreio's Operation License (page 2 of 3)







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Fica o empreendedor obrigado ao adimplemento de todas as parcelas vincendas, quando o pagamento dos custos for através da opção de parcelamento.

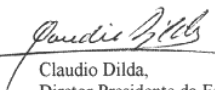
Caso venha a ocorrer alteração nos atos constitutivos, a empresa deverá apresentar, imediatamente, cópia da mesma à FEPAM, sob pena do empreendedor acima identificado continuar com a responsabilidade sobre a atividade/empreendimento licenciada por este documento.


Esta Licença só é válida para as condições contidas acima e até 14/06/2008. Porém, caso algum prazo estabelecido nesta licença for descumprido, automaticamente esta perderá sua validade. Este documento também perderá a validade caso os dados fornecidos pelo empreendedor não correspondam à realidade.

Esta Licença não dispensa nem substitui quaisquer alvarás ou certidões de qualquer natureza exigidos pela legislação Federal, Estadual ou Municipal, nem exclui as demais licenças ambientais.

Esta licença deverá estar disponível no local da atividade licenciada para efeito de fiscalização.

Porto Alegre, 30 de março de 2004.

  
Claudio Dilda,  
Diretor Presidente da Fepam.

FEPAM - DIV. LICENCIAMENTO
DATA: 30/03/2004
ASS: 

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Identificador do Documento = 149842

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**Figure 12. CR do Recreio's Operation License (page 31 of 3)**

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



**F.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 CRRLGP 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 *Central de Resíduos do Recreio* is one of the few landfills that has the Environmental License from FEPAM. It can be stated that SIL 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 the environmental agency.

**SECTION G. Stakeholders' comments**

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

Previously to the development of CRRLGP, SIL made a public call for comments from local stakeholders when constructing CR do Recreio.

Now, 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 SIL 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 Minas do Leão – RS / *Municipal Administration of Minas do Leão - RS*
- Secretaria Municipal de Agricultura / *Municipal Agriculture Secretariat*;
- Câmara dos Vereadores de Minas do Leão – RS / *Municipal Legislation Chamber of Minas do Leão - RS*
- Secretaria Estadual do Meio Ambiente / *Environmental Secretariat of Rio Grande do Sul State*
- Associação dos Moradores do Bairro Coréia / *Coréia District Representative Association*
- Ministério Público do Estado do Rio Grande do Sul / *Public Ministry of Rio Grande do Sul State*
- Fórum Brasileiro de ONGs / *Brazilian NGO Forum*

**G.2. Summary of the comments received:**

SIL received comments from Associação dos Moradores do Bairro Coréia, from Secretaria Municipal de Agricultura, from Prefeitura Municipal de Minas do Leão and from Secretaria Estadual do Meio Ambiente. In summary, the four comments congratulate SIL for the CRRLGP's initiative and say that the use of degraded areas as a landfill is a positive measure that results on the recovery of the area, reducing the environmental impact and is an important measure to the correct disposal of urban waste.

The comments also say that the burn of the biogas will contribute to improve the environmental conditions, eliminating the gas odor that reaches the local population.

Finally, the four comments say that CRRLGP will contribute with the sustainable development, will enhance the population's local income and will generate jobs.



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

SIL appreciated the four comments received, which confirms all the positive impacts from CRRLGP. The comments were received as an incentive for SIL to implement the project at CR do Recreio.

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	SIL – Soluções Ambientais Ltda.
Street/P.O.Box:	Rodovia BR 290 – km 181
Building:	
City:	Minas do Leão
State/Region:	RS
Postfix/ZIP:	967555-000
Country:	Brazil
Telephone:	+55 (51) 3652.2962 +55 (51) 9807.3698 +55 (51) 3221.5569
FAX:	+55 (51) 3652.2962 +55 (51) 3221.5569
E-Mail:	<a href="mailto:silsolucoes@sil-residuos.com.br">silsolucoes@sil-residuos.com.br</a>
URL:	<a href="http://www.sil-residuos.com.br">www.sil-residuos.com.br</a>
Represented by:	
Title:	Mr.
Salutation:	
Last Name:	Hartmann
Middle Name:	
First Name:	Fernando
Department:	Director
Mobile:	+55 (51) 9985.0567
Direct FAX:	+55 (51) 3221.5569
Direct tel:	+55 (51) 3221.5569
Personal E-Mail:	<a href="mailto:fernando@sil-residuos.com.br">fernando@sil-residuos.com.br</a>

Annex 2**INFORMATION REGARDING PUBLIC FUNDING**

There is no public funding for the CRRLGP.

Annex 3**BASELINE INFORMATION****Table 1. Baseline determination information**

DATA	VALUE	UNIT	SOURCE
<b><math>L_0</math> (methane potential generation)</b>	0,07	$\text{m}^3_{\text{CH}_4}/\text{kg}_{\text{waste}}$	USEPA <sup>7</sup>
<b>k (decay constant)</b>	0,1	1/year	
<b>Year of opening</b>	2001		SIL
<b>Year of closure</b>	2014		
<b><math>R_x</math></b>	Variable	$\text{kg}_{\text{waste}}$	
<b>EAF (Emission Adjustment Factor)</b>	20	%	

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  $\text{ft}^3/\text{lb}$ ). Converting the units to  $\text{m}^3_{\text{CH}_4}/\text{kg}_{\text{waste}}$ , the value assumed for  $L_0$  is 0,07.

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 SIL, from 2001 to 2005. Data from 2006 on were estimated by SIL.

Project Emissions due to electricity purchased were estimated through approved methodology ACM0002 – Consolidated methodology for grid-connected electricity generation from renewable sources – version 3. 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.

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.

<sup>7</sup> 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



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.

The provided information covers years 2002, 2003 and 2004, and is the most recent information available at this stage (At the end of 2005 ONS supplied raw dispatch data for the whole interconnected grid in the form of daily reports<sup>8</sup> from Jan. 1, 2002 to Dec. 31, 2004, the most recent information available at this stage).

### 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:

$$EF_{OM, simple\ adjusted, y} = (1 - \lambda_y) \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_j GEN_{j,y}} + \lambda_y \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} \quad (\text{tCO}_2\text{e/GWh})$$

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

$$\frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_k GEN_{k,y}} = 0 \quad (\text{tCO}_2\text{e/GWh})$$

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 2002, 2003 and 2004.

The Lambda factors were calculated in accordance with methodology requests. More detailed information is provided in Annex 3. The table below presents such factors.

Year	Lambda
2002	0,5053
2003	0,5312
2004	0,5041

<sup>8</sup> *Acompanhamento Diário da Operação do Sistema Interligado Nacional*. ONS-CNOS, Centro Nacional de Operação do Sistema. Daily reports on the whole interconnected electricity system from Jan. 1, 2002 to Dec. 31, 2004.



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

Year	Electricity Load (MWh)
2002	275.402.896
2003	288.493.929
2004	297.879.874

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

$$EF_{OM, simple\_adjusted, 2002} = (1 - \lambda_{2001}) \frac{\sum_{i,j} F_{i,j,2002} \cdot COEF_{i,j}}{\sum_j GEN_{j,2002}} \therefore EF_{OM, simple\_adjusted, 2002} = 0,4207 \text{ tCO}_2/\text{MWh}$$

$$EF_{OM, simple\_adjusted, 2003} = (1 - \lambda_{2003}) \frac{\sum_{i,j} F_{i,j,2003} \cdot COEF_{i,j}}{\sum_j GEN_{j,2003}} \therefore EF_{OM, simple\_adjusted, 2003} = 0,4397 \text{ tCO}_2/\text{MWh}$$

$$EF_{OM, simple\_adjusted, 2004} = (1 - \lambda_{2004}) \frac{\sum_{i,j} F_{i,j,2004} \cdot COEF_{i,j}}{\sum_j GEN_{j,2004}} \therefore EF_{OM, simple\_adjusted, 2004} = 0,4327 \text{ tCO}_2/\text{MWh}$$

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

$$EF_{OM, simple\_adjusted \text{ 2002-2004}} = 0,4310 \text{ tCO}_2/\text{MWh}$$

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

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

Electricity generation in this case means 20% of total generation in the most recent year (2004), 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:

$$EF_{BM, 2004} = 0,0962 \text{ tCO}_2/\text{MWh}$$

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:

$$EF_{electricity, 2002-2004} = 0,5 * 0,4310 + 0,5 * 0,0962 = 0,2636 \text{ tCO}_2/\text{MWh}$$



It is important to note that adequate considerations on the above weights are currently under study by the Meth Panel, and there is a possibility that such weighing changes in the methodology here applied.

The baseline emissions would then be proportional to the electricity delivered to the grid throughout the project's lifetime. Baseline emissions due to displacement of electricity are calculated by multiplying the electricity baseline emissions factor ( $EF_{electricity,2002-2004}$ ) with the electricity generation of the project activity.

$BE_{electricity,y} = EF_{electricity,2002-2004} \cdot EC_y$ , where  
 $EC_y$  = electricity consumed by the blower during year  $y$  (MWh);

Therefore, for the first crediting period, the baseline emissions will be calculated as follows:

$BE_{electricity,y} = 0,2636 \text{ tCO}_2/\text{MWh} \cdot EC_y$  (in  $\text{tCO}_2\text{e}$ )

The leakage emissions would then be proportional to the electricity purchased from the grid throughout the project's lifetime. Leakage emissions due to purchase of electricity are calculated by multiplying the electricity emissions factor ( $EF_{electricity,2002-2004}$ ) with the electricity purchase of the project activity, as put in section E.2.

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 is increasingly showing that integration is bound to happen in the future. In 1998, the Brazilian government was announcing 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 had been established, technical papers still divided the Brazilian system in two (Bosi, 2000)<sup>9</sup>:

“... 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, Bosi (2000) gives a strong argument in favor of having so-called *multi-project baselines*:

“For large countries with different circumstances within their borders and different power grids based in these different regions, multi-project baselines in the electricity sector may need to be disaggregated below the country-level in order to provide a credible representation of ‘what would have happened otherwise’”.

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<sup>9</sup> Bosi, M. *An Initial View on Methodologies for Emission Baselines: Electricity Generation Case Study*. International Energy Agency. Paris, 2000.





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. It has also to be considered that only in 2004 the interconnection between SE and NE was concluded, i.e., if project proponents are to be coherent with the generation database they have available as of the time of the PDD submission for validation, a situation where the electricity flow between the subsystems was even more restricted is to be considered.

The Brazilian electricity system nowadays comprises of around 91.3 GW of installed capacity, in a total of 1,420 electricity generation enterprises. From those, nearly 70% are hydropower plants, around 10% are natural gas-fired power plants, 5.3% are diesel and fuel oil plants, 3.1% 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 8.1 GW of installed capacity in neighboring countries (Argentina, Uruguay, Venezuela and Paraguay) that may dispatch electricity to the Brazilian grid. (<http://www.aneel.gov.br/aplicacoes/capacidadebrasil/OperacaoCapacidadeBrasil.asp>). This latter capacity is in fact comprised by mainly 6.3 GW of the Paraguayan part of *Itaipu Binacional*, a hydropower plant operated by both Brazil and Paraguay, but whose energy almost entirely is sent to the Brazilian grid.

Approved methodology ACM0002 asks project proponents to account for "all generating sources serving the system". In that way, when applying one of these methodologies, project proponents in Brazil should search for, and research, all power plants serving the Brazilian system.

In fact, information on such generating sources is not publicly available in Brazil. The national dispatch center, ONS – *Operador Nacional do Sistema* – 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 2002, 2003 and 2004.

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 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 ([http://www.aneel.gov.br/arquivos/PDF/Resumo\\_Gr%C3%A1ficos\\_mai\\_2005.pdf](http://www.aneel.gov.br/arquivos/PDF/Resumo_Gr%C3%A1ficos_mai_2005.pdf)), 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 <sub>2</sub> /MWh)	ONS Data Build Margin (tCO <sub>2</sub> /MWh)
0,205	0,0962

Therefore, considering all the rationale explained, project developers decided for the database considering 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 2002 (with operation start in 2002, 2003 and 2004) 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 (2002 to 2004). For that reason project participants find the application of such numbers to be not only reasonable but the best available option.

The aggregated hourly dispatch data got from ONS was used to determine the lambda factor for each of the years with data available (2002, 2003 and 2004). The Low-cost/Must-run generation was determined as the total generation minus fossil-fuelled thermal plants generation, this one determined through daily dispatch data provided by ONS. 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. First, the table with the 130 plants dispatched by the ONS is provided. Then, a table with the summarized conclusions of the analysis, with



the emission factor calculation displayed. Next, the load duration curves for the S-SE-MW system are presented. Finally, a graphic showing the total estimated methane generated at the baseline scenario and the methane captured and destroyed is presented.



Table 2. ONS Dispatched Plants -1/2

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
1	S-SE-CO	G	Termo Rio	Nov-2004	423,3	0,30	15,3	99,5%	0,670
2	S-SE-CO	H	Candonga	Sep-2004	140,0	1,00	0,0	0,0%	0,000
3	S-SE-CO	H	Queimado	May-2004	105,0	1,00	0,0	0,0%	0,000
4	S-SE-CO	G	Norte Fluminense	Feb-2004	880,2	0,30	15,3	99,5%	0,670
5	S-SE-CO	H	Jauru	Sep-2003	121,5	1,00	0,0	0,0%	0,000
6	S-SE-CO	H	Gaúporé	Sep-2003	120,0	1,00	0,0	0,0%	0,000
7	S-SE-CO	G	Três Lagoas	Aug-2003	306,0	0,30	15,3	99,5%	0,670
8	S-SE-CO	H	Funil (MG)	Jan-2003	180,0	1,00	0,0	0,0%	0,000
9	S-SE-CO	H	Itiquira I	Sep-2002	156,1	1,00	0,0	0,0%	0,000
10	S-SE-CO	G	Araucária	Sep-2002	484,5	0,30	15,3	99,5%	0,670
11	S-SE-CO	G	Canoas	Sep-2002	180,6	0,30	15,3	99,5%	0,670
12	S-SE-CO	H	Piraju	Sep-2002	81,0	1,00	0,0	0,0%	0,000
13	S-SE-CO	G	Nova Piratininga	Jun-2002	384,9	0,30	15,3	99,5%	0,670
14	S-SE-CO	O	PCT CGTEE	Jun-2002	5,0	0,30	20,7	99,0%	0,902
15	S-SE-CO	H	Rosal	Jun-2002	55,0	1,00	0,0	0,0%	0,000
16	S-SE-CO	G	Ibirité	May-2002	226,0	0,30	15,3	99,5%	0,670
17	S-SE-CO	H	Cana Brava	May-2002	465,9	1,00	0,0	0,0%	0,000
18	S-SE-CO	H	Sta. Clara	Jan-2002	60,0	1,00	0,0	0,0%	0,000
19	S-SE-CO	H	Machadinho	Jan-2002	1.140,0	1,00	0,0	0,0%	0,000
20	S-SE-CO	G	Juiz de Fora	Nov-2001	87,0	0,28	15,3	99,5%	0,718
21	S-SE-CO	G	Macaé Merchant	Nov-2001	922,6	0,24	15,3	99,5%	0,837
22	S-SE-CO	H	Lajeado (ANEEL res. 402/2001)	Nov-2001	902,5	1,00	0,0	0,0%	0,000
23	S-SE-CO	G	Eletrobolt	Oct-2001	379,0	0,24	15,3	99,5%	0,837
24	S-SE-CO	H	Porto Estrela	Sep-2001	112,0	1,00	0,0	0,0%	0,000
25	S-SE-CO	G	Cuiaba (Mario Covas)	Aug-2001	529,2	0,30	15,3	99,5%	0,670
26	S-SE-CO	G	W. Arjona	Jan-2001	194,0	0,25	15,3	99,5%	0,804
27	S-SE-CO	G	Uruguiana	Jan-2000	639,9	0,45	15,3	99,5%	0,447
28	S-SE-CO	H	S. Caxias	Jan-1999	1.240,0	1,00	0,0	0,0%	0,000
29	S-SE-CO	H	Canoas I	Jan-1999	82,5	1,00	0,0	0,0%	0,000
30	S-SE-CO	H	Canoas II	Jan-1999	72,0	1,00	0,0	0,0%	0,000
31	S-SE-CO	H	Igarapava	Jan-1999	210,0	1,00	0,0	0,0%	0,000
32	S-SE-CO	H	Porto Primavera	Jan-1999	1.540,0	1,00	0,0	0,0%	0,000
33	S-SE-CO	D	Cuiaba (Mario Covas)	Oct-1998	529,2	0,27	20,2	99,0%	0,978
34	S-SE-CO	H	Sobragi	Sep-1998	80,0	1,00	0,0	0,0%	0,000
35	S-SE-CO	H	PCH FMAF	Jan-1998	26,0	1,00	0,0	0,0%	0,000
36	S-SE-CO	H	PCH CEEE	Jan-1998	25,0	1,00	0,0	0,0%	0,000
37	S-SE-CO	H	PCH ENERSUL	Jan-1998	43,0	1,00	0,0	0,0%	0,000
38	S-SE-CO	H	PCH CEB	Jan-1998	15,0	1,00	0,0	0,0%	0,000
39	S-SE-CO	H	PCH ESCELSA	Jan-1998	62,0	1,00	0,0	0,0%	0,000
40	S-SE-CO	H	PCH CELESC	Jan-1998	50,0	1,00	0,0	0,0%	0,000
41	S-SE-CO	H	PCH CEMAT	Jan-1998	145,0	1,00	0,0	0,0%	0,000
42	S-SE-CO	H	PCH CELG	Jan-1998	15,0	1,00	0,0	0,0%	0,000
43	S-SE-CO	H	PCH CERJ	Jan-1998	59,0	1,00	0,0	0,0%	0,000
44	S-SE-CO	H	PCH COPEL	Jan-1998	70,0	1,00	0,0	0,0%	0,000
45	S-SE-CO	H	PCH CEMIG	Jan-1998	84,0	1,00	0,0	0,0%	0,000
46	S-SE-CO	H	PCH CPFL	Jan-1998	55,0	1,00	0,0	0,0%	0,000
47	S-SE-CO	H	S. Mesa	Jan-1998	1.275,0	1,00	0,0	0,0%	0,000
48	S-SE-CO	H	PCH EPAULO	Jan-1998	26,0	1,00	0,0	0,0%	0,000
49	S-SE-CO	H	Guilmar Amorim	Jan-1997	140,0	1,00	0,0	0,0%	0,000
50	S-SE-CO	H	Corumbá	Jan-1997	375,0	1,00	0,0	0,0%	0,000
51	S-SE-CO	H	Miranda	Jan-1997	408,0	1,00	0,0	0,0%	0,000
52	S-SE-CO	H	Noav Ponte	Jan-1994	510,0	1,00	0,0	0,0%	0,000
53	S-SE-CO	H	Segredo (Gov. Ney Braga)	Jan-1992	1.260,0	1,00	0,0	0,0%	0,000
54	S-SE-CO	H	Taquaruçu	Jan-1989	554,0	1,00	0,0	0,0%	0,000
55	S-SE-CO	H	Manso	Jan-1988	210,0	1,00	0,0	0,0%	0,000
56	S-SE-CO	H	D. Francisca	Jan-1987	125,0	1,00	0,0	0,0%	0,000
57	S-SE-CO	H	Itá	Jan-1987	1.450,0	1,00	0,0	0,0%	0,000
58	S-SE-CO	H	Rosana	Jan-1987	369,2	1,00	0,0	0,0%	0,000
59	S-SE-CO	N	Angra	Jan-1985	1.874,0	1,00	0,0	0,0%	0,000
60	S-SE-CO	H	T. Irmãos	Jan-1985	807,5	1,00	0,0	0,0%	0,000
61	S-SE-CO	H	Itaipu 60 Hz	Jan-1983	6.300,0	1,00	0,0	0,0%	0,000
62	S-SE-CO	H	Itaipu 50 Hz	Jan-1983	5.375,0	1,00	0,0	0,0%	0,000
63	S-SE-CO	H	Emborcação	Jan-1982	1.192,0	1,00	0,0	0,0%	0,000
64	S-SE-CO	H	Nova Avanhandava	Jan-1982	347,4	1,00	0,0	0,0%	0,000
65	S-SE-CO	H	Gov. Bento Munhoz - GBM	Jan-1980	1.676,0	1,00	0,0	0,0%	0,000

\* Subsystem: S - south, SE-CO - Southeast-Midwest

\*\* Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. Banco de Informações da Geração (<http://www.aneel.gov.br>), data collected in november 2004).

[2] Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. Road testing baselines for GHG mitigation projects in the electric power sector. OECD/IEA information paper, October 2002.

[3] Intergovernmental Panel on Climate Change. Revised 1996 Guidelines for National Greenhouse Gas Inventories.

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. Acompanhamento Diário da Operação do SIN (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. Resumo Geral dos Novos Empreendimentos de Geração (<http://www.aneel.gov.br>), data collected in november 2004).



Table 3. ONS Dispatched Plants -2/2

	Subsystem*	Fuel source**	Power plant	Operation start [2, 4, 5]	Installed capacity (MW) [1]	Fuel conversion efficiency (%) [2]	Carbon emission factor (tC/TJ) [3]	Fraction carbon oxidized [3]	Emission factor (tCO2/MWh)
66	S-SE-CO	H	S. Santiago	Jan-1980	1 420,0	1,00	0,0	0,0%	0,000
67	S-SE-CO	H	Itumbiara	Jan-1980	2 280,0	1,00	0,0	0,0%	0,000
68	S-SE-CO	O	Igarapé	Jan-1978	131,0	0,30	20,7	99,0%	0,902
69	S-SE-CO	H	Itauba	Jan-1978	512,4	1,00	0,0	0,0%	0,000
70	S-SE-CO	H	A. Vermelha (Jose E. Moraes)	Jan-1978	1 396,2	1,00	0,0	0,0%	0,000
71	S-SE-CO	H	S. Simão	Jan-1978	1 710,0	1,00	0,0	0,0%	0,000
72	S-SE-CO	H	Capivara	Jan-1977	640,0	1,00	0,0	0,0%	0,000
73	S-SE-CO	H	S. Osório	Jan-1975	1 078,0	1,00	0,0	0,0%	0,000
74	S-SE-CO	H	Marimbondo	Jan-1975	1 440,0	1,00	0,0	0,0%	0,000
75	S-SE-CO	H	Promissão	Jan-1975	264,0	1,00	0,0	0,0%	0,000
76	S-SE-CO	C	Pres. Medici	Jan-1974	446,0	0,26	26,0	98,0%	1,294
77	S-SE-CO	H	Volta Grande	Jan-1974	380,0	1,00	0,0	0,0%	0,000
78	S-SE-CO	H	Porto Colômbia	Jun-1973	320,0	1,00	0,0	0,0%	0,000
79	S-SE-CO	H	Passo Fundo	Jan-1973	220,0	1,00	0,0	0,0%	0,000
80	S-SE-CO	H	Passo Real	Jan-1973	158,0	1,00	0,0	0,0%	0,000
81	S-SE-CO	H	Ilha Solteira	Jan-1973	3 444,0	1,00	0,0	0,0%	0,000
82	S-SE-CO	H	Mascarenhas	Jan-1973	131,0	1,00	0,0	0,0%	0,000
83	S-SE-CO	H	Gov. Parigot de Souza - GPS	Jan-1971	252,0	1,00	0,0	0,0%	0,000
84	S-SE-CO	H	Chavantes	Jan-1971	414,0	1,00	0,0	0,0%	0,000
85	S-SE-CO	H	Jaguara	Jan-1971	424,0	1,00	0,0	0,0%	0,000
86	S-SE-CO	H	Sá Carvalho	Apr-1970	78,0	1,00	0,0	0,0%	0,000
87	S-SE-CO	H	Estreito (Luiz Carlos Barreto)	Jan-1969	1 050,0	1,00	0,0	0,0%	0,000
88	S-SE-CO	H	Ibitinga	Jan-1969	131,5	1,00	0,0	0,0%	0,000
89	S-SE-CO	H	Jupia	Jan-1969	1 551,2	1,00	0,0	0,0%	0,000
90	S-SE-CO	O	Alegrete	Jan-1968	66,0	0,26	20,7	99,0%	1,040
91	S-SE-CO	G	Campos (Roberto Silveira)	Jan-1968	30,0	0,24	15,3	99,5%	0,837
92	S-SE-CO	G	Santa Cruz (RJ)	Jan-1968	766,0	0,31	15,3	99,5%	0,648
93	S-SE-CO	H	Parabuna	Jan-1968	85,0	1,00	0,0	0,0%	0,000
94	S-SE-CO	H	Limoeiro (Armando Salles de Olive	Jan-1967	32,0	1,00	0,0	0,0%	0,000
95	S-SE-CO	H	Caconde	Jan-1966	80,4	1,00	0,0	0,0%	0,000
96	S-SE-CO	C	J.Lacerda C	Jan-1965	363,0	0,25	26,0	98,0%	1,345
97	S-SE-CO	C	J.Lacerda B	Jan-1965	262,0	0,21	26,0	98,0%	1,602
98	S-SE-CO	C	J.Lacerda A	Jan-1965	232,0	0,18	26,0	98,0%	1,869
99	S-SE-CO	H	Bariri (Alvaro de Souza Lima)	Jan-1965	143,1	1,00	0,0	0,0%	0,000
100	S-SE-CO	H	Funil (RJ)	Jan-1965	216,0	1,00	0,0	0,0%	0,000
101	S-SE-CO	C	Figueira	Jan-1963	20,0	0,30	26,0	98,0%	1,121
102	S-SE-CO	H	Furnas	Jan-1963	1 216,0	1,00	0,0	0,0%	0,000
103	S-SE-CO	H	Barra Bonita	Jan-1963	140,8	1,00	0,0	0,0%	0,000
104	S-SE-CO	C	Charqueadas	Jan-1962	72,0	0,23	26,0	98,0%	1,462
105	S-SE-CO	H	Jurumirim (Armando A. Laydner)	Jan-1962	97,7	1,00	0,0	0,0%	0,000
106	S-SE-CO	H	Jacui	Jan-1962	180,0	1,00	0,0	0,0%	0,000
107	S-SE-CO	H	Pereira Passos	Jan-1962	99,1	1,00	0,0	0,0%	0,000
108	S-SE-CO	H	Tres Marias	Jan-1962	396,0	1,00	0,0	0,0%	0,000
109	S-SE-CO	H	Euclides da Cunha	Jan-1960	108,8	1,00	0,0	0,0%	0,000
110	S-SE-CO	H	Camargos	Jan-1960	46,0	1,00	0,0	0,0%	0,000
111	S-SE-CO	H	Santa Branca	Jan-1960	56,1	1,00	0,0	0,0%	0,000
112	S-SE-CO	H	Cachoeira Dourada	Jan-1959	658,0	1,00	0,0	0,0%	0,000
113	S-SE-CO	H	Salto Grande (Lucas N. Garcez)	Jan-1958	70,0	1,00	0,0	0,0%	0,000
114	S-SE-CO	H	Salto Grande (MG)	Jan-1958	102,0	1,00	0,0	0,0%	0,000
115	S-SE-CO	H	Mascarenhas de Moraes (Peixoto)	Jan-1956	478,0	1,00	0,0	0,0%	0,000
116	S-SE-CO	H	Itutinga	Jan-1955	52,0	1,00	0,0	0,0%	0,000
117	S-SE-CO	C	S. Jerônimo	Jan-1954	20,0	0,26	26,0	98,0%	1,294
118	S-SE-CO	O	Carioba	Jan-1954	36,2	0,30	20,7	99,0%	0,902
119	S-SE-CO	O	Piratininga	Jan-1954	472,0	0,30	20,7	99,0%	0,902
120	S-SE-CO	H	Canastra	Jan-1953	42,5	1,00	0,0	0,0%	0,000
121	S-SE-CO	H	Nilo Peçanha	Jan-1953	378,4	1,00	0,0	0,0%	0,000
122	S-SE-CO	H	Fontes Nova	Jan-1940	130,3	1,00	0,0	0,0%	0,000
123	S-SE-CO	H	Henry Borden Sub.	Jan-1926	420,0	1,00	0,0	0,0%	0,000
124	S-SE-CO	H	Henry Borden Ext.	Jan-1926	469,0	1,00	0,0	0,0%	0,000
125	S-SE-CO	H	I. Pombos	Jan-1924	189,7	1,00	0,0	0,0%	0,000
126	S-SE-CO	H	Jaguari	Jan-1917	11,8	1,00	0,0	0,0%	0,000
Total (MW) =					66.007,1				

\* Subsystem: S - south, SE-CO - Southeast-Midwest

\*\* Fuel source (C, bituminous coal; D, diesel oil; G, natural gas; H, hydro; N, nuclear; O, residual fuel oil).

[1] Agência Nacional de Energia Elétrica. Banco de Informações de Geração (<http://www.aneel.gov.br>), data collected in november 2004).

[2] Bosl, M., A. Laurence, P. Maldonado, R. Schaeffer, A.F. Simoes, H. Winkler and J.M. Lukamba. Road testing baselines for GHG mitigation projects in the electric power sector. OECD/IEA Information paper, October 2002.

[3] Intergovernmental Panel on Climate Change. Revised 1996 Guidelines for National Greenhouse Gas Inventories.

[4] Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. Acompanhamento Diário da Operação do SIN (daily reports from Jan. 1, 2001 to Dec. 31, 2003).

[5] Agência Nacional de Energia Elétrica. Superintendência de Fiscalização dos Serviços de Geração. Resumo Geral dos Novos Empreendimentos de Geração (<http://www.aneel.gov.br>), data collected in november 2004).



## Summary table

Emission factors for the Brazilian South-Southeast-Midwest interconnected grid				
Baseline (including imports)	$EF_{OM}$ [tCO <sub>2</sub> /MWh]	Load [MWh]	LCMR [GWh]	Imports [MWh]
2002	0,8504	275.402.896	258.720	1.607.395
2003	0,9378	288.493.929	274.649	459.586
2004	0,8726	297.879.874	284.748	1.468.275
Total (2001-2003) =		861.776.699	818.118	3.535.256
	$EF_{OM, simple-adjusted}$ [tCO <sub>2</sub> /MWh]	$EF_{BM, 2004}$	Lambda	
	0,4310	0,0962	$\lambda_{2002}$	
	Alternative weights	Default weights	0,5053	
	$w_{OM} = 0,75$	$w_{OM} = 0,5$	$\lambda_{2003}$	
	$w_{BM} = 0,25$	$w_{BM} = 0,5$	0,5312	
	$EF_{CM}$ [tCO <sub>2</sub> /MWh]	Default $EF_{OM}$ [tCO <sub>2</sub> /MWh]	$\lambda_{2004}$	
	0,3473	0,2636	0,5041	

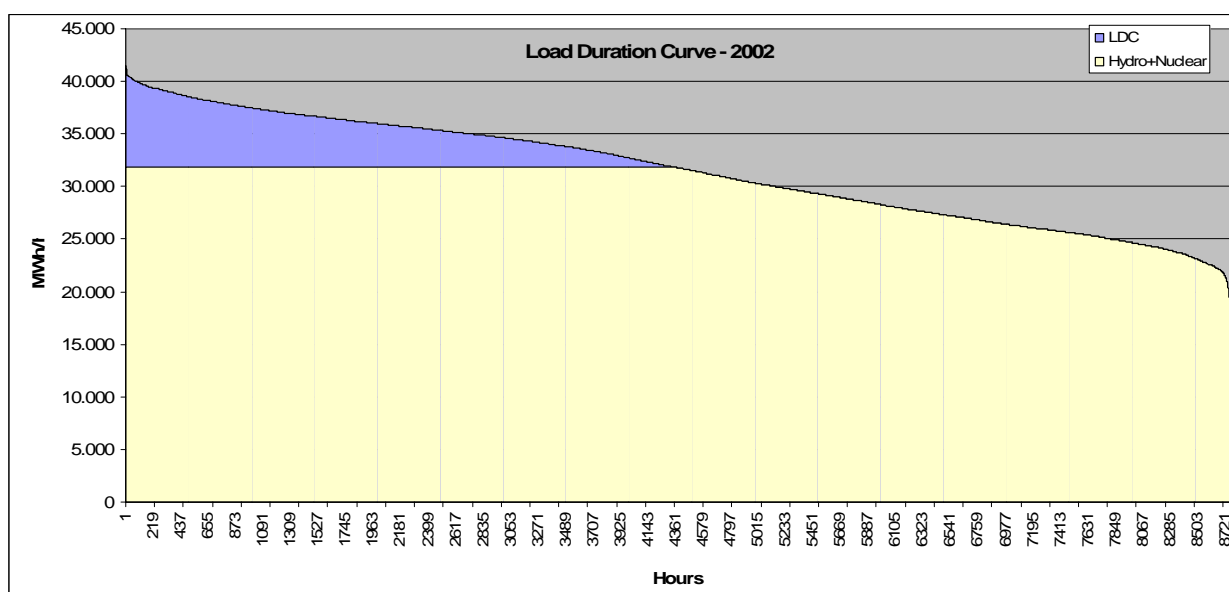


Figure 13. Load duration curve for the S-SE-MW system, 2002

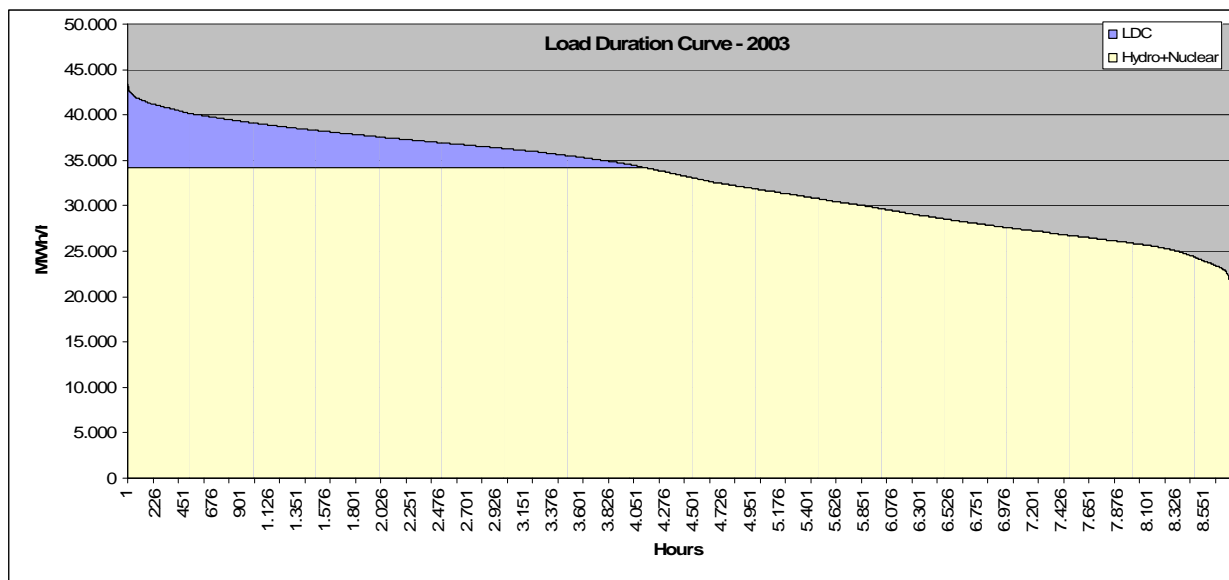


Figure 14. Load duration curve for the S-SE-MW system, 2003

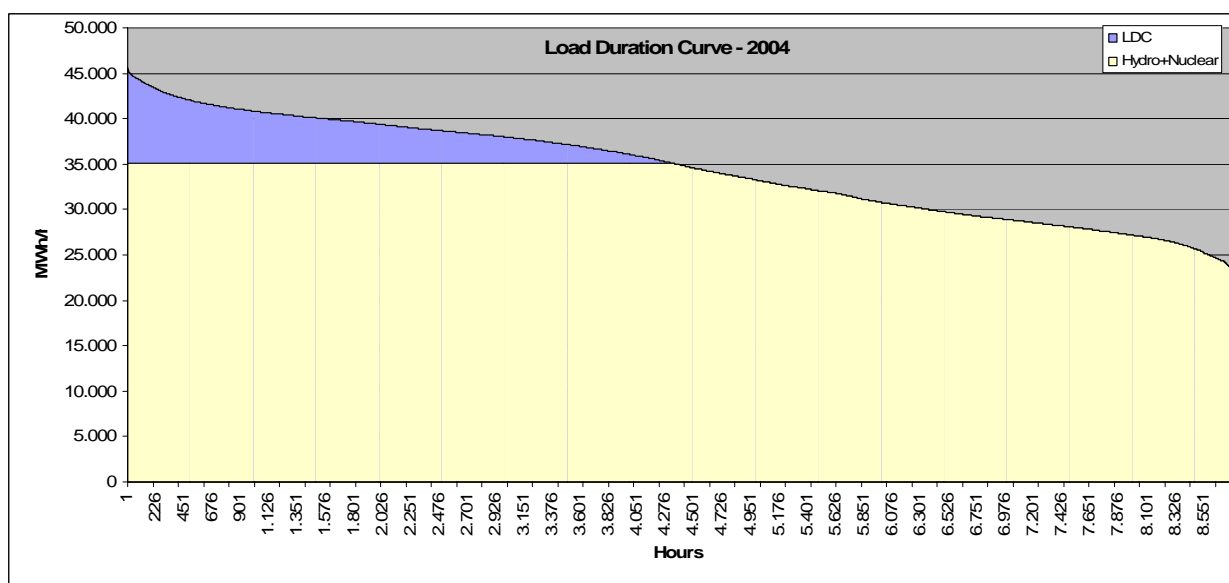


Figure 15. Load duration curve for the S-SE-MW system, 2004

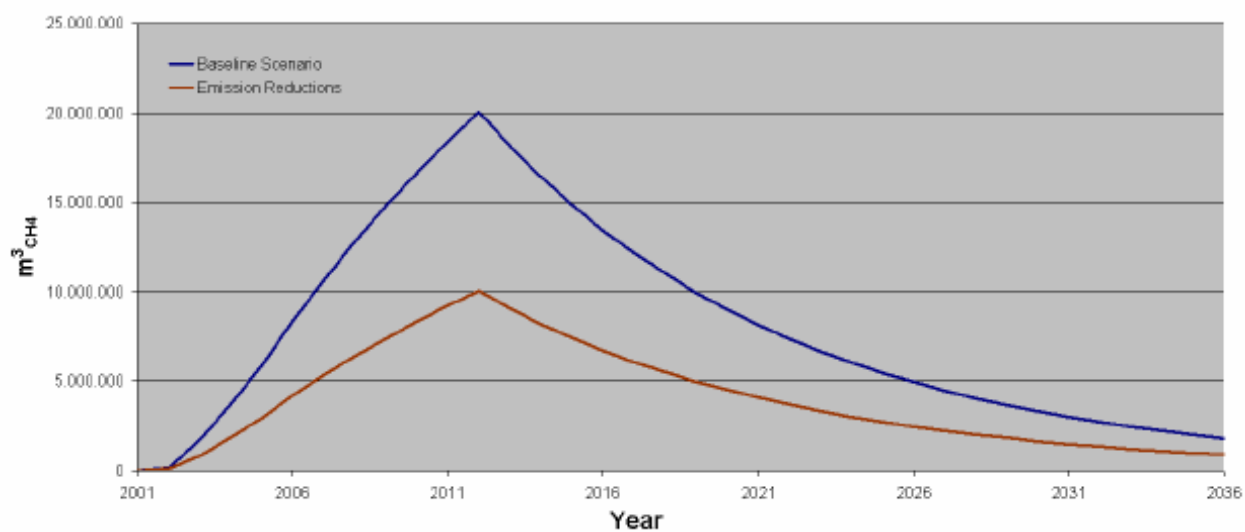


Figure 16. Baseline Emission and Emission Reductions from CR do Recreio



**Annex 4****MONITORING PLAN**

As stated in section D of this document, the following variables need to be measured in order to determine and account for emission reductions thanks to the CRRLGP.

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

Except from the flare efficiency, all other data need to be monitored continuously, through proper meters or analyzers. The flare efficiency will be measured continuously (by the operating hours of the flare and by the average temperature of the combustion chamber) and quarterly or monthly (if instable) through the percentage of methane in the fluegas.

Considering that the CRRLGP'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. The summary table for such report will be filled in, with the metered data provided as background.

**Table 4. Summary worksheet for CRRLGP**

Date	LFG to flares (m3)	Methane on LFG (%)	Hours of flare operation	Average temperature of the combustion chamber (°C)	LFG Pressure (mbar)	Blower's Electricity Consumption (MWh)
1/1/2007						
2/1/2007						
3/1/2007						
4/1/2007						
5/1/2007						
6/1/2007						
7/1/2007						
8/1/2007						
9/1/2007						

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 crediting periods. They will be presented to the verifier as the collected and stored data for verification purposes. The workbook will also keep electronic information on the flares' efficiencies, as tests are carried out accordingly. Table 3 shows how the flares' data are to be archived.



Table 5. Flare efficiency data

Flares' Efficiency Tests				
Flare #	Test Date	Methane Content in Exhaust Gas	Test Carried Out by	Approved by