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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

Embralixo/Araúna - Bragança Landfill Gas Project (EABLGP)
Version 06
Date: 05/03/2007

A.2. Description of the project activity:

A.2.1. The purpose of the project activity:

Embralixo/Araúna - Bragança landfill gas Project and activities intend to sequestrate and burn greenhouse gases emissions due to the garbage decomposition. For attaining this objective, project was defined in 6 stages, as follows:

1 – PDD conception and validation within established UNFCCC rules.
2 – PDD and validation report subscription to DNA approval.
3 – Registering, trough validation report and letter of approval of DNA, the project on the Executive Board of UNFCCC.
4 – Implement the Project infrastructure.
5 – Verify project and start operation and monitoring.
6 – Certify, periodically, the project until the end of crediting period.

Stages are being planned to flow sequentially. Stage 4 timing may be changed due to investments decisions.

The Crediting Period planned for this project has the duration of 7 years.

The purpose for project activity is to reduce greenhouse gas emissions on atmosphere, justifying the investments made trough Certified Emissions Reduction (CERs). CDM was the path found for project viability.

The Project Activity will reduce the GHG emissions through the implementation of an active landfill gas capturing system. Such a system is common on Europeans and North American landfills, making the technology well developed and simple.

As nor Brazilian State or County legislation requires the gas to be captured, burned or used and there is no perception on intention to do so. The authorities focus is to improve the adequacy of the dumping to avoid that the environment contamination by leachate leakage from waste residues reaching water and soil.

The only obligation to capture or burn the gas is due the high risk of explosion, and the common systems implemented are passive venting system which do not have the efficiency to capture a significant amount of gas. Usually the captured gas is not intentionally burned, which causes the disposal of methane directly to the atmosphere.

Bragança Paulista has, according to year 2000 Brazilian National Census, 125,031 habitants. The solid residues collected in the city, unless dangerous industrial waste is addressed to Bragança landfill where it is compacted and properly stored. Not only solid residues are compressed and treated but liquid residues are weekly removed and underground water quality is monitored. Bragança landfill has a total area of 145,224 squared meters where 48,575 are being used for waste disposal.

The waste disposal is documented since 1990 and the operation is forecasted to close in 2015. The daily average of solid residues received in 2005 is 164 tons. Historical average is 144 tons. The decomposition of this residues will emit an estimate of 52,145,187 m^3 (cubic meters) of methane between January 2008 and December 2014. As the project activity evolves a significant part of this greenhouse gas emission will be ceased.

A.2.2. The view of project participants of the contribution of the project activity to sustainable development:

Araúna Participações e Investimentos Ltda has great satisfaction in coordinating this CDM project. Araúna Participações e Investimentos Ltda performance on this project represents the consolidation of the activity in this business area since it is not the first experience of Araúna in CDM projects. Business model adopted by Araúna Participações e Investimentos Ltda has the will to establish and disseminate the Sustainable Development. According to Mr. Maurício Maruca, Araúna's Partner-Director "our expectations, on this project, is to attain expressive results in the promotion of Sustainable Development". Developing a project that represents potential of reducing greenhouse gases emissions was possible through internal and external, specialized consultants, teams that was allocated, strengthen the commitment of enterprises executives and global leadership that Brazil has on CDM projects.
The expectation is that the CERs generated will justify the investments being made and is promoting, landfill modernization, work conditions improvement, reduction of environmental impacts inherent to landfill activities, reduction of air pollution and improving life quality of the neighborhood. Other effects as skill development and transfer, wealth, direct and indirect employment generated through the investments are also expected.

a) Araúna Participações e Investimentos Ltda has dedicated its efforts with the conviction of being able to perform and grow, in a competitive environment, through focus action in Sustainable Development. In Araúna's Partner-Director, Mr. Nino S. Bottini, words. "Sustainable Development is the enterprises challenge for the XXI century. Araúna Participações is well positioned because it was created for this business model. Corporations, in general view, will have to adapt to new regulatory and market exigencies since the customers are getting conscientious for the future challenges, which means, present competitive condition".

b) Embralixo - Empresa Bragantina de Varrição e Coleta de Lixo Ltda understands the project as a big contribution for Sustainable Development, mainly regarding the environment. Landfill presence is a requirement in regions that have large waste generation due to human activities and consumption behavior. Landfill's activities are essential to ensure public health conditions in urban areas. When asked about expectations regarding the project, landfill owner, Mr.Manuel J. Rodrigues declared. "The fact of being able, besides of the waste removal, to reduces the environmental impacts of solid residues decomposition makes us very proud and satisfied".

Bragança project will, not only improve environmental preservation, but generate new activities in landfill dependencies, raise the knowledge regarding environment care, making work conditions better and neighborhood life more pleasant. It is worth mention that 2% of CERs sales income will be addressed to promote Sustainable Development in the neighborhood through financing local community projects

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)	• Araúna Participações e Investimentos Ltda (Private Entity) • Embralixo - Empresa Bragantina de Varrição e Coleta de Lixo Ltda. (Private Entity)	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.		

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

- Bragança Paulista Sanitary Landfill.

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:

- Bragança Paulista.

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

- Estrada Municipal do Campo Novo, without number, Campo Novo - Bragança Paulista - São Paulo ZIP Code 12900-000

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

- Waste handling and disposal. Scope number 13.

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

The technology to be used in the project activity is available in the Brazilian market, consisting basically of a vertical drains system interconnected to tubing which is connected to the suction and flaring equipment. This materials and equipment are made in Brazil.

Companies that design and build flares usually operate in wider markets such as combustion, landfill technology or environmental engineering, since the market generated by the CDM projects, such a EABLGP, is still small. However, the interaction with Brazilian companies make noticeable the growing interest on this new market, which means that those projects are stimulating the capturing flaring systems market.

Yet, there are a number of companies which manufacture many units per annum and who operate both national and internationally. There are also many smaller light engineering companies in Brazil which produce more basic flares but who do not have the same grounding in combustion or environmental engineering.

The technology for the collected landfill gas flaring includes:

- Biogas flare with 98% of efficiency;
- Continuous and automated pilot, using LPG/LFG;
- Ignition and control panel with Processing Central Logistic(CLP – Central Logística de Processamento);
- Hydraulic seal in the base;
- Flaring monitored;
- Monitoring systems according to the monitoring plan;
- Gas filtering and drying system through decanting.

The company responsible for providing the flares should also provide all needed documents for the approval and final registry, including drawings, operation and maintenance manual.

A list of these documents will be prepared in due time. Furthermore, the company will assist the training of operators, start, technical assistance and consulting. Including all the specialized engineering services and related to the Biogas System as flowchart elaboration, data sheets, specifications, reports, manuals or other services eventually required and not included among the items above.

Also, the maintenance of the equipment will be hired from specialized companies, which will help to ensure the maximum performance of the system.

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

The period of credit chosen is 7 years. In the table below it is shown the emissions reductions for the first crediting period.

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be in using the following tabular format	
Years	**Annual estimation of emission reductions in tones of CO_2e**
2008	**66.008**
2009	**66.047**
2010	**66.145**
2011	**66.298**
2012	**66.501**
2013	**66.750**
2014	**67.041**
Total estimated reductions (tones of CO_2e)	**464.791**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tones of CO_2e)	**66.399**

A.4.5. Public funding of the project activity:

There is no public financing for the 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:

Approved consolidated baseline and monitoring methodology ACM0001 (version 05):
"Consolidated baseline methodology for landfill gas project activities".

The ACM0001 dawns upon:

- ACM0002 latest version (version 06) or AMSI. D
- "Tool for demonstration and assessment of additionality" latest version (version 03)
- "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:

The ACM0001 is an approved consolidated methodology applicable to landfill gas capture project activities such as:

- The captured gas is flared;
- The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reduction are claimed for displacing or avoiding energy from other sources;
- The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reduction are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable Sources". If capacity of electricity generated is less than 15 MW, and/or thermal energy displaced is less than 54 TJ (15GWh), small-scale methodologies can be used.

As the EABLGP project activity fits the first item, since the project consists in simple capture and flare the gas generated by the landfill, the methodology is applicable to this project activity.

The Environmental documentation is on annex 3 showing that there are no legal requirements, allowing the project to be implemented as above.

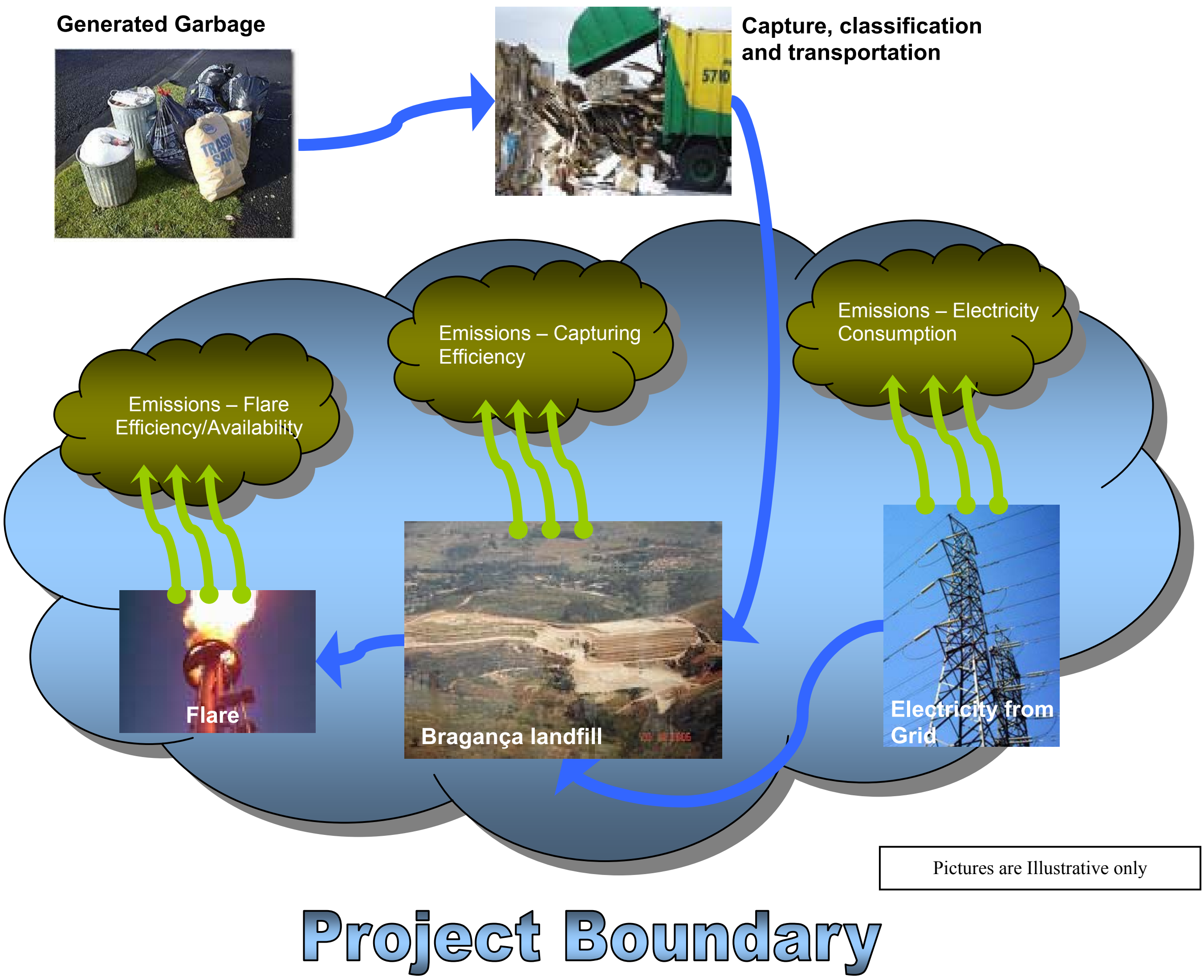
B.3. Description of the sources and gases included in the project boundary

	Source	Gas	Included?	Justification/ Explanation
Baseline	Machinery Diesel Consumption	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	No	Baseline and Project Activity emissions are the same.
		N_2O	No	Baseline and Project Activity emissions are the same.
	Electricity for the infrastructure	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	No	Baseline and Project Activity emissions are the same.
		N_2O	No	Baseline and Project Activity emissions are the same.
	Methane Emission due to decomposition of organic waste	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	Yes	Main source of GHG emission on a landfill.
		N_2O	No	Project Activity emissions are a little smaller then Baseline.
Project Activity	Machinery Diesel Consumption	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	No	Baseline and Project Activity emissions are the same.
		N_2O	No	Baseline and Project Activity emissions are the same.
	Electricity for the infrastructure	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	No	Baseline and Project Activity emissions are the same.
		N_2O	No	Baseline and Project Activity emissions are the same.
	Additional Electricity for the infrastructure	CO_2	Yes	Will be discounted from the claimed credits
		CH_4	No	Not Relevant.
		N_2O	No	Not Relevant.
	Methane Emission due to decomposition of organic waste	CO_2	No	Baseline and Project Activity emissions are the same.
		CH_4	Yes	Methane that will not be captured or burned.
		N_2O	No	Project Activity emissions are a little smaller then Baseline.

The project boundary is the site of the project activity where the gas is captured and destroyed/used.

Possible CO_2 emissions resulting from combustion of other fuels than the methane recovered should be accounted as project emissions. Such emissions may include fuel combustion due to pumping and collection of landfill gas or fuel combustion for transport of generated heat to the consumer locations. In addition, electricity required for the operation of the project activity, including transport of heat, should be accounted and monitored. As the project activity does not involve electricity generation, project participants should account for CO_2 emissions by multiplying the quantity of electricity required with the CO_2 emissions intensity of the electricity displaced.

The project boundary is limited to the area currently occupied by Bragança landfill because there are no emissions that might be attributed to the project activities that are outside its perimeter.



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

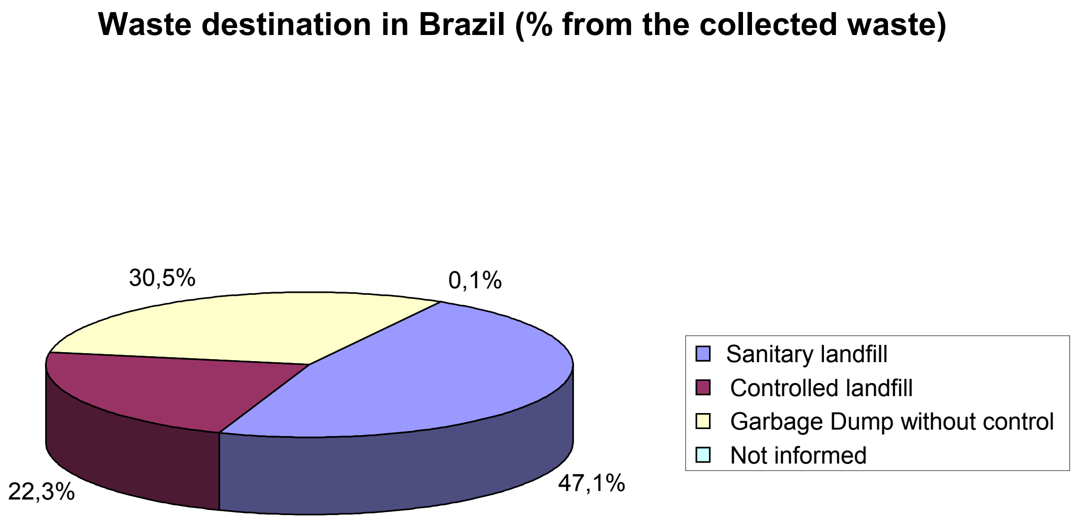
The most probable alternatives are:

- Alternative 1: The landfill operator would invest in LFG capture and flaring not undertaken as a CDM project activity. Due to the current Brazilian legislation, the location and conditions of the landfill, the achievement of Option 1 above is not probable. It would not be an economically attractive course of action for the landowner nor for the landfill operator. Therefore its adoption is not plausible.

- Alternative 2: The landfill operator would maintain the present activities according to the common practice of not flaring the landfill gas from its landfill operations, since there are no regulations regarding the emissions of methane. This is the most plausible course of action if the project activity is not considered.

- Alternative 3: The landfill operator would invest in LFG capture and utilization to produce electricity or for commercial purposes.
  The LFG do not produce enough energy to make return on investment (ROI) to produce electricity for commercial purpose. Regarding that fact there are several constrains due to electricity distribution market complexity, which are not the core business of landfill Owner.

According to the 2000 National Research on Sanitation (Pesquisa Nacional de Saneameto Básico 2000), made by IBGE (Instituto Brasileiro de Geografia e Estatística - Statistics and Geographic Brazilian Institute), from a total estimated volume of garbage collected in Brazil (161,827.1 t/day) 47.1% of the collected garbage was dumped on sanitary landfills, 22.3% was dumped on "controlled" landfills and 30.5% was dumped on "Garbage dumping sites" without any control.



Nor Brazilian State or County legislation requires the gas to be captured, burned or used and there is no perception on intention to do so. The focus is to improve the adequacy of the dumping to avoid that the environment contamination by leakage from waste residues reaches water and soil. This can be noticed by the improve that occurred through the last years, since in 1989 only 10,7% of the collected garbage was dumped on Sanitary or Controlled landfills against 69% in the year 2000 (see above).

In few cases there are obligations to capture or burn the gas, however, those obligations are due the high risk of explosion, and the common systems implemented are quite simple and do not have the efficiency to capture a significant amount of gas. Usually the captured gas is not intentionally burned, which causes the disposal of methane directly to the atmosphere. The methane destructions have being stimulated by CDM projects, which can be confirmed by the development of Brazilians CDM projects on landfill gas capture (2 projects registered and 2 with request for registration, November 2005).

The implementation of such a project incurs in financial costs that undermine the intention on reducing theses GHG emissions. Since there are no laws to enforce those reductions there are no reason to believe that such projects would happen without the Kyoto protocol and the CDM projects.

As there is no attractiveness on alternatives that would reduce the GHG emissions on landfills like Bragança Landfill, the current scenario is the most probable, which lead to the choice of the baseline.

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):

ACM0001 requires the use of the "Tool for demonstration and assessment of additionality" version 3 to prove the project is not the baseline scenario. This tool is applied as follows.

Preliminary screening based on the starting date of the project activity

The Project Participants do not wish to have the crediting period starting prior to the registration of their project activity. The project activity will start on 01/10/2006 and the first crediting period is scheduled to 01/01/2008, after the registration of the project.

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

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

The alternatives to the project activity are:

- Alternative 1: The landfill operator would invest in LFG capture and flaring not undertaken as a CDM project activity. Due to the current Brazilian legislation, the location and conditions of the landfill, the achievement of Option 1 above is not probable. It would not be an economically attractive course of action for the landowner nor for the landfill operator. Therefore its adoption is not plausible.

- Alternative 2: The landfill operator would maintain the present activities according to the common practice of not flaring the landfill gas from its landfill operations, since there are no regulations regarding the emissions of methane. This is the most plausible course of action if the project activity is not considered.

- Alternative 3: The landfill operator would invest in LFG capture and utilization to produce electricity or for commercial purposes.
  The LFG do not produce enough energy to make return on investment (ROI) to produce electricity for commercial purpose. Regarding that fact there are several constrains due to electricity distribution market complexity, which are not the core business of landfill Owner.

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

- Alternative 1: The alternative 1 is compliance to all applicable laws and regulations as explicated in this sub-step on the Project Activity item, since this alternative is similar to the project activity, but is not undertaken as a CDM project activity.

- Alternative 2: The present activities are also in compliance with all applicable laws and regulations as shown through the documentation annex to this PDD.

- Alternative 3: The commercialization of electricity generated by landfill gas is possible to be done in accordance to applicable laws and regulations to the landfill operation as much as to the distribution of electricity to the grid, as seen on Bagasse cogeneration CDM projects. However, in the case of Bragança landfill the financial return would not be sufficient to encourage landfill owner or landfill operator to implement such a project.

- Project Activity: In the present context the proposed baseline scenario might be described like this:

There is no gas capture and treatment in the site, only a ventilation system; thus, the release of the landfill gas without obstacles will continue in these guidelines until a time in the future when the capture and treatment of landfill gas could be required by law or could become an economically attractive course of action. These alterations in the possible future of the baseline will be followed by a monitoring plan elaborated for the project.

This scenario is the base for the definition of the emission reductions of the project. Due to the uncertainty of the gas volume to be captured by the current ventilation system, it's affirmed that the volume of captured gas is low, since most of the methane is generated in the deeper layers of the landfill. The gas flux in the top of the upper layers (where the decomposition is mostly aerobic) is so low that no type of flaring is possible, verifying solely the ventilation. The existing contractual documents do not determine capturing or flaring the gas. On the landfill there is a venting system that do not support the burning of the LFG, since is a concrete drain that do not support the temperature of the flame. Besides the capturing system used on the landfill today is so inefficient that the gas captured is not adequate to be burned. Furthermore, its reasonable to assume that a very low volume of gas will be flared.

As shown in A.4.4, Brazil does not have any law to mitigate landfill gas emissions. In São Paulo State, CETESB - Companhia de Tecnologia de Saneamento Ambiental, the environmental agency, has been acting towards closing rubbish dumps and forcing municipalities to give proper destination to the generated waste. That may be done through concessions to private entities either to build and operate sanitary landfills or to be responsible for the whole municipality's waste management. In all cases, however, active collection and flaring of the landfill gas has never been required.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

Since there is no intention to produce electricity commercially, and there will be no profitable activities neither cost reduction on the project. The Option I – simple cost analysis – is chosen.

Sub-step 2b – Option I. Apply simple cost analysis

The Bragança landfill operates without flaring the LFG. There are no reasons to believe that a more efficient LFG capturing system and flaring system would be installed for safety, operational reasons or because of the odor problems. The installation of a LFG capture and flaring system, even an inefficient one, would require costs for the landfill owner with no sort of financial compensation, compromising its business viability.

Since the flaring of the gases represent an effort to improve the environmental quality of the landfill, without the generation of energy or any sub-products of the activity that might bring profit or dividends, the project does not present economically attractive results.

Estimated costs from project implementation and operation:

Embralixo / Araúna - Bragança landfill Gas Project - EABLGP				
Estimated Expenses to implement and operate the project				
	Implementation	7	14	21
Stated Period		0 to 7 years	8 to 14 years	15 to 21 years
Preliminary costs, PDD, Construction Projects, Mechanical Projects, etc	€ 146.886,00	€ 4.459,00	€ 83.207,00	€ 83.207,00
Construction Work	€ 424.525,00	€ 29.715,00	€ 29.715,00	€ 29.715,00
Validation, Certification and UNFCCC taxes	€ 60.000,00	€ 35.000,00	€ 95.000,00	€ 95.000,00
Administration, operation, maintenance and monitoring	€ 0,00	€ 483.156,00	€ 483.156,00	€ 483.156,00
Security and surveillance	€ 0,00	€ 194.040,00	€ 194.040,00	€ 194.040,00
Financial Expenses	€ 95.155,00	€ 46.050,00	€ 5.825,00	€ 5.825,00
Insurances	€ 8.491,00	€ 54.084,00	€ 54.084,00	€ 54.084,00
Total Annual Expenses	€ 735.057,00	€ 846.504,00	€ 945.027,00	€ 945.027,00
Accumulated Expenses	**€ 735.057,00**	**€ 1.581.561,00**	**€ 2.526.588,00**	**€ 3.471.615,00**

Step 4. Common practice analysis

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

There is no similar activities to EABLGP, without consider other similar CDM projects, being carried out in Brazil at the current moment.

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

Considering that there is no similar activities widely observed and commonly carried out, it is not possible to perform an analysis at this point.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The ACM0001 is an approved consolidated methodology applicable to landfill gas capture project activities such as:

- The captured gas is flared;
- The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reduction are claimed for displacing or avoiding energy from other sources;
- The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reduction are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable Sources". If capacity of electricity generated is less than 15 MW, and/or thermal energy displaced is less than 54 TJ (15GWh), small-scale methodologies can be used.

As the EABLGP project activity fits the first item, since the project consists in simple capture and flare the gas generated by the landfill, the methodology is applicable to this project activity.

As explained above the applicability of the methodology is adequate to the project activity proposed in this PDD.

As demanded by the methodology the "Tool for the demonstration and assessment of additionality" is developed on the B.5. item to define the baseline scenario. On a defined baseline scenario the next considerations were applied as indicated by the ACM0001 methodology.

As specified by the methodology the emission reduction of CO_2e shall be calculated as follows:

$$ER_Y = (MD_{project,y} - MD_{reg,y}) \cdot GWP_{CH4} + EL_y \cdot CEF_{electricitry} - ET_y \cdot CEF_{termal}$$

Where:

ER_Y - Emission reduction in a given year "y"

$MD_{project,y}$ - Methane actually Destroyed by the project activity

$MD_{reg,y}$ - Methane that would be destroyed without the project activity

GWP_{CH4} - Methane Global warming potential, 21 tCO_2e/tCH_4 according to the methodology

EL_y - Net quantity of electricity exported during the year in megawatt hours

$CEF_{electricitry}$ - CO_2 emission intensity of the electricity displaced

ET_y - incremental quantity of thermal energy displaced during the year

CEF_{termal} - CO_2 emission intensity of thermal energy displaced

In this specific project there will be neither thermal energy production nor electricity production, so the followings components of the equation will not generate emission reductions:

$ET_y = 0$

EL_y is calculated as:

$$EL_y = EL_{EX,LGFG} - EL_{IMP}$$

considering that $EL_{EX,LGFG}$=0 since there is no electricity export in the project.

As estimated on the item B.6.3. the EL_{IMP} = 268,8 MWh (30Kw x 8760 hours).

$EF_{electricity}$= 0,2636 tCO_2e/MWh

Consequently:

$MD_{eletricity}$ = -70 tCO_2e per year

$MD_{eletricity,y}$ Total in 7 Years = -490 tCO_2e

EL_{IMP} will be monitored as described on the D2.2.1 item.

As there are no regulatory or contractual requirements specifying $MD_{reg,y}$ the "Adjustment Factor" shall be used:

$$MD_{reg,y} = MD_{project,y} \cdot AF$$

To Bragança landfill there are, absolutely, no regulations or contract requirements that generate the Methane destruction. On the landfill there is a venting system that do not support the burning of the LFG, since is a concrete drain that do not support the temperature of the flame. Besides the capturing system used on the landfill today is so inefficient that the gas captured is not adequate to be burned. So the Adjustment Factor considered was 10%, as conservative action, since the methane can not be burned nowadays.

For *ex ante* emissions estimate of the baseline scenario the 2000 IPCC "Good Practice Guide" suggests the utilization of the First Order Decay method, tier 2.

The equation that expresses the FOD method follows:

$$CH_4(Gg/yr) = \sum_x [(A \cdot k \cdot MSW_T(x) \cdot MSW_F(x) \cdot L_0(x)) \cdot e^{-k(t-x)}]$$

Where
t = year of inventory

x = years for which input data should be added
k = methane generation rate constant (1/yr)
$A = (1 - e^{-k})/k$; normalization factor which corrects the summation
$MSW_T(x)$ = Total municipal waste generated in year x (Gg/yr)
L_0 = methane generation potential [MCF(x) . DOC(x) . $DOC_F(x)$. 16/12(Gg CH_4/Gg waste)]
MCF(x) = methane correction factor in year x (fraction)
DOC(x) = degradable organic carbon (DOC) in year x (fraction) (Gg C/Gg waste)
DOC_F = fraction of (DOC) dissimilated
16/12 = Conversion from C to CH_4

And

DOC_F = 0.14*T(°C)+0,28

As, there are almost no information available, the “k” and “L_0” parameters were researched within the literature. According to “A landfill Gas to Energy Handbook for landfill Owners e Operators” (December 1994), the value of "k" depends on the local weather conditions and residue composition. To estimate this value the table presented below was used:

Variable	Range	Suggested Values		
		Humid climate	Medium	Dry climate
Lo (cf/lb)	0-5	2.25-2.88	2.25-2.88	2.25-2.88
k (1/yr)	0.003-0.40	0.1-0.35	0.05-0.15	0.02-0.10

Source: “A landfill Gas to Energy Handbook for landfill Owners e Operators” (December 1994), part 1, pages 2-9 - Landfill Control Technologies, “ Landfill Gas System Engineering Design Seminar”, 1994

In the State of São Paulo, where Bragança Paulista is located, the weather type is humid and adopting the most conservative value, ”k” used was 0.1 (1/year).

According to USEPA the "L_0" factor depends on the composition of the garbage and the landfill conditions for the processing of decomposition (methane generation), being the values available in the literature between 4.4 to 194 kg CH4/ton of residue (Pelt, 1998). For the years of 1941 to 1989, the “L_0” value is 165 kg of CH4/ton of residue, as suggested by USEPA (Levelton, 1991) Ortech, 1994, established a “L_0” for use of 117 Kg CH4/ton of residue. Therefore it is being adopted conservatively the value corresponding to a L_0 = 117 kg CH_4/ton of residue (or 2.7379 cf/lb of residue). 40% of the total LFG produced was considered as losses through the skirts of the landfill. The availability of the flare considered on this project is 96% (recommended by manufacturer).

Regarding the flare efficiency the choice, in compliance with “Tool to determine project emissions from flaring gases containing methane”, is to continuous monitor the methane destruction efficiency of the enclosed flare (the Flare efficiency) planed for this project:

The tool involves the following seven steps:
STEP 1: Determination of the mass flow rate of the residual gas that is flared
STEP 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas
STEP 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis
STEP 4: Determination of methane mass flow rate of the exhaust gas on a dry basis

STEP 5: Determination of methane mass flow rate of the residual gas on a dry basis
STEP 6: Determination of the hourly flare efficiency
STEP 7: Calculation of annual project emissions from flaring based on measured hourly values or based on default flare efficiencies.

Project participants shall apply these steps to calculate project emissions from flaring ($PE_{flare,y}$) based on the measured hourly flare efficiency or based on the default values for the flare efficiency ($\eta_{flare,h}$).

The calculation procedure in this tool determines the flow rate of methane before and after the destruction in the flare, taking into account the amount of air supplied to the combustion reaction and the exhaust gas composition (oxygen and methane). The flare efficiency is calculated for each hour of a year based either on measurements or default values plus operational parameters. Project emissions are determined by multiplying the methane flow rate in the residual gas with the flare efficiency for each hour of the year.

STEP 1. Determination of the mass flow rate of the residual gas that is flared

This step calculates the residual gas mass flow rate in each hour *h*, based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,h} \times FV_{RG,h}$$

$FM_{RG,h}$ - kg/h Mass Flow rate of residual gas in hour *h;*

$\rho_{RG,h}$ - kg/m^3 Density of residual gas at normal conditions in hour *h*;

$FV_{RG,h}$ - m^3/h Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*

And:

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h} \times T_n}}$$

$\rho_{RG,n,h}$ - kg/m3 Density of the residual gas at normal conditions in hour *h*

P_n - kg/m3 Density of the residual gas at normal conditions in hour *h*

R_u -Pa Atmospheric pressure at normal conditions (101 325)

$MM_{RG,h}$ - kg/kmol Molecular mass of the residual gas in hour *h*

T_n -K Temperature at normal conditions (273.15)

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i)$$

$MM_{RG,h}$ - kg/kmol Molecular mass of the residual gas in hour *h*

$fv_{i,h}$ - Volumetric fraction of component i in the residual gas in the hour *h*

MM_i -kg/kmol Molecular mass of residual gas component i

I - kgThe components CH4, CO, CO2, O2,H2, N2

As a simplified approach, project participants may only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N2).

STEP 2. Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas, calculated from the volumetric fraction of each component *i* in the residual gas, as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RgG,h}}$$

$fm_{i,h}$ - Mass fraction of element j in the residual gas in hour *h*

$fv_{i,h}$ - Volumetric fraction of component i in the residual gas in the hour *h*

AM_j -kg/kmol Atomic mass of element j

$NA_{j,i}$ - Number of atoms of element j in component i

$MM_{RG,h}$ - kg/kmol Molecular mass of the residual gas in hour *h*

j - The elements carbon, hydrogen, oxygen and nitrogen

i - The components CH4, CO, CO2, O2,H2, N2

STEP 3. Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is applicable to this project as the methane combustion efficiency of the flare is continuously monitored.

Determine the average volumetric flow rate of the exhaust gas in each hour *h* based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas, as follows:

$$TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h}$$

$TV_{n,FG,h}$ - m3/h - Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*

$V_{n,FG,h}$ - m3/kg residual gas - Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour *h*

$FM_{RG,h}$ - kg residual gas/h - Mass flow rate of the residual gas in the hour *h*

$$V_{n,FG,h} = V_{n,CO_2,h} + V_{n,O_2,h} + V_{n,N_2,h}$$

$V_{n,FG,h}$ - m3/kg residual gas - Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour *h*

$V_{n,CO2,h}$ - m3/kg residual gas - Quantity of CO2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$V_{n,N2,h}$ - m3/kg residual gas -Quantity of N2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$V_{n,O2,h}$ - m3/kg residual gas - Quantity of O2 volume free in the exhaust gas of the flare

$$V_{n,O_2,h} = n_{O_2,h} \times MV_n$$

$V_{n,O2,h}$ - m3/kg residual gas - Quantity of O2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$n_{O2,h}$ - kmol/kg residual gas - Quantity of moles O2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

MV_n - m3/kmol -Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)

$$V_{n,N_2,h} = MV_n * \left\{ \frac{fm_{N,h}}{200 AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) * \left[F_h + n_{O_2,h} \right] \right\}$$

$V_{n,N2,h}$ - m3/kg residual gas - Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

MV_n - m3/kmol - Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m3/Kmol)

$fm_{N,h}$ - Mass fraction of nitrogen in the residual gas in the hour *h*

AM_n - kg/kmol - Atomic mass of nitrogen

MF_{O2} - O_2 volumetric fraction of air

F_h - kmol/kg residual gas - Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*

$n_{O2,h}$ - kmol/kg residual gas - Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$$V_{n,CO_2,h} = \frac{fm_{C,h}}{AM_C} * MV_n$$

$V_{n,CO2,h}$ - m3/kg residual gas - Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$fm_{C,h}$ - Mass fraction of carbon in the residual gas in the hour *h*

AM_C - kg/kmol - Atomic mass of carbon

MV_n - m3/kmol - Volume of one mole of any ideal gas at normal temperature and pressure (22.4 m3/Kmol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{\left\{1 - \left(t_{O_2,h} / MF_{O_2}\right)\right\}} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2 AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) \times F_h \right]$$

$n_{O2,h}$ - kmol/kg residual gás - Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$t_{O2,h}$ - Volumetric fraction of O_2 in the exhaust gas in the hour *h*

MF_{O2} - Volumetric fraction of O_2 in the air (0.21)

F_h - kmol/kg - residual gas - Stochiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*

$fm_{j,h}$ - Mass fraction of element *j* in the residual gas in hour *h* (from equation 4)

AM_j - kg/kmol - Atomic mass of element *j*

j - The elements carbon (index C) and nitrogen (index N)

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} + \frac{fm_{O,h}}{AM_O}$$

F_h - kmol O_2/kg residual gás - Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*

$fm_{j,h}$ - Mass fraction of element *j* in the residual gas in hour *h* (from equation 4)

AM_j - kg/kmol Atomic mass of element *j*

j - The elements carbon (index C), hydrogen (index H) and oxygen (index O)

STEP 4. Determination of methane mass flow rate in the exhaust gas on a dry basis

The mass flow of methane in the exhaust gas is based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH_4,FG,h}}{1000000}$$

$TM_{FG,h}$ - kg/h - Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*

$TV_{n,FG,h}$ - m^3/h exhaust gas - Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*

$fv_{CH4,FG,h}$ - mg/m^3 - Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h*

STEP 5. Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$), the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($\rho_{CH4,n,h}$) in the same reference conditions (normal conditions and dry or wet basis).

It is necessary to refer both measurements (flow rate of the residual gas and volumetric fraction of methane in the residual gas) to the same reference condition that may be dry or wet basis. If the residual gas moisture is significant (temperature greater than 60ºC), the measured flow rate of the residual gas that is usually referred to wet basis should be corrected to dry basis due to the fact that the measurement of methane is usually undertaken on a dry basis (i.e. water is removed before sample analysis).

$$TM_{RG,h} = FV_{RG,h} * fv_{CH_4,RG,h} \times \rho_{CH_4,n}$$

$TM_{RG,h}$ - kg/h - Mass flow rate of methane in the residual gas in the hour *h*

$FV_{RG,h}$ - m3/h-Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*

$fv_{CH4,RG,h}$ - Volumetric fraction of methane in the residual gas on dry basis in hour *h* (NB: this corresponds to $fv_{i,RG,h}$ where *i* refers to methane).

$\rho_{CH4,n}$ - kg/m3 - Density of methane at normal conditions (0.716)

STEP 6. Determination of the hourly flare efficiency

As the approach selected by the project participants is to use a enclosed flare, and monitor it continuously, the flare efficiency in the hour *h* ($\eta_{flare,h}$) is:

- 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour h.
- determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour *h* :

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

$\eta_{flare,h}$ - Flare efficiency in the hour *h*

$TM_{FG,h}$ - kg/h - Methane mass flow rate in exhaust gas averaged in a period of time t (hour, two months or year)

$TM_{RG,h}$ - kg/h - Mass flow rate of methane in the residual gas in the hour *h*

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour h, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour h ($\eta_{flare,h}$), as follows:

$$PE_{flare,y} = \sum_{n=1}^{8760} TM_{RG,h} \times (1 - \eta_{Flare,h}) \times \frac{GWP_{CH_4}}{1000}$$

$PE_{flare,y}$ - Project emissions from Flaring of the residual gas stream in year y (tCO_2e)

$TM_{RG,h}$ - Mass flow rate of the methane in the residual gas in the hour h (kg/h)

$\eta_{Flare,h}$ - Flare efficiency in hour h

GWP_{CH_4} - Global Warming Potential of Methane valid for the commitment period (tCO_2e/tCH_4)

Which is equal to:

$$PE_{flare,y} = TM_{RG,h} \times (1 - FA) \times (1 - \eta_{Flare,h}) \times \frac{GWP_{CH_4}}{1000}$$

FA - Flare availability in percentage of operating hours (%) where there is a 98% of flare efficiency.

Project Parameters	
Year when operation started	1990
Year when flaring started	2008
Lo(kg CH4/ton of residue)	117
k(1/year)	0,1
GWP(CH4)	21
w (% of methane in LFG)	50%
Gas capture efficiency	70%
Flare efficiency (*ex-ante estimation*)	98%
Flare Availability (*ex-ante estimation*)	96%
EAF	10%
Energy Consumption (MWh/year)	262,8
Emission Factor (Grid energy utilization) (tCO_2/MWh)	0,2636
Total waste from 1990 to 2013 (tons)	1.298.125
Average waste/year from 1990 to 2013 (tons)	54.089

As required by the methodology the next equation concludes the estimation of methane destruction:

$$MD_{flared,y} = (LFG_{flared,y} \cdot w_{CH_4} \cdot D_{CH_4}) - (PE_{flare,y} / GWP_{CH_4})$$

$MD_{flared,y}$ = Quantity of methane destroyed by flaring

$LFG_{flared,y}$ = Volume o landfill gas flared

$w_{CH_4,y}$ = The average methane fraction of the landfill gas

D_{CH_4} = Methane density

From the quantity of methane destroyed($MD_{flared,y}$), the emission reduction in tCO_2e was obtained using the GWP_{CH4}=21 given by the methodology.

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

There are only 3 parameters that are available at validation that influence actual emission reduction of the project over the first crediting period, which are:

Data / Parameter:	**AF**
Data unit:	Percentage (%)
Description:	Adjustment Factor to the Baseline
Source of data used:	Estimated
Value applied:	10%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The volume of captured gas is low, since most of the methane is generated in the deeper layers of the landfill, and most of the landfill gas escape(nowadays) through the skirts of the landfill. The gas flux in the top of the upper layers (where the decomposition is mostly aerobic) is so low that flaring not always possible, verifying mostly the ventilation. The existing contractual documents do not determine capturing or flaring the gas. On the landfill there is an implemented venting system that does not, adequately, support the burning of the LFG. So, it is reasonable to assume that a very low volume of gas will be flared, less then 10% of the generated landfill gas.
Any comment:	

Data / Parameter:	Regulatory requirements relating to landfill gas projects
Data unit:	Text
Description:	Regulatory requirements relating to landfill gas projects
Source of data used:	Laws
Value applied:	Important
Justification of the choice of data or description of measurement methods and procedures actually applied :	➢ The Regulatory requirements for landfills will be assessed yearly. ➢ All the data will be recorded yearly, on an electronic database. The responsible person/entity will be defined on the project verification.
Any comment:	

Data / Parameter:	**$CEF_{electricity,y}$**
Data unit:	tCO_2e/MWh

Description:	CO_2 emission intensity of the electricity and/or other energy carriers in ID 9.
Source of data used:	Information from the
Value applied	Not Important, since it represents approximately 0.055% of the estimated emission reductions.
Justification of the choice of data or description of measurement methods and procedures actually applied :	➢ Calculation according to ACM0002 Methodology.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Baseline

For *ex ante* emissions estimate of the baseline scenario the 2000 IPCC "Good Practice Guide" suggests the utilization of the First Order Decay method, tier 2.

The equation that expresses the FOD method follows:

$$CH_4(Gg/yr) = \sum_x [(A \cdot k \cdot MSW_T(x) \cdot MSW_F(x) \cdot L_0(x)) \cdot e^{-k(t-x)}]$$

Where
t = year of inventory
x = years for which input data should be added
k = methane generation rate constant (1/yr)
$A = (1 - e^{-k})/k$; normalization factor which corrects the summation
$MSW_T(x)$ = Total municipal waste generated in year x (Gg/yr)
L_0 = methane generation potential [MCF(x) . DOC(x) . DOC_F(x) . 16/12(Gg CH_4/Gg waste)]
MCF(x) = methane correction factor in year x (fraction)
DOC(x) = degradable organic carbon (DOC) in year x (fraction) (Gg C/Gg waste)
DOC_F = fraction of (DOC) dissimilated
16/12 = Conversion from C to CH_4

And

DOC_F = 0.14*T(°C)+0,28

As, there are almost no information available, the "k" and "L_0" parameters were researched within the literature. According to "A landfill Gas to Energy Handbook for landfill Owners e Operators" (December 1994), the value of "k" depends on the local weather conditions and residue composition. To estimate this value the table presented below was used:

Variable	Range	Suggested Values		
		Humid climate	Medium	Dry climate
Lo (cf/lb)	0-5	2.25-2.88	2.25-2.88	2.25-2.88

k (1/yr)	0.003-0.40	0.1-0.35	0.05-0.15	0.02-0.10

Source: "A landfill Gas to Energy Handbook for landfill Owners e Operators" (December 1994), part 1, pages 2-9 - Landfill Control Technologies, " Landfill Gas System Engineering Design Seminar", 1994

In the State of São Paulo, where Bragança Paulista is located, the weather type is humid and adopting the most conservative value, "k" used was 0.1 (1/year).

According to USEPA the "L_0" factor depends on the composition of the garbage and the landfill conditions for the processing of decomposition (methane generation), being the values available in the literature between 4.4 to 194 kg CH4/ton of residue (Pelt, 1998). For the years of 1941 to 1989, the "L_0" value is 165 kg of CH4/ton of residue, as suggested by USEPA (Levelton, 1991) Ortech, 1994, established a "L_0" for use of 117 Kg CH4/ton of residue. Therefore it is being adopted conservatively the value corresponding to a L_0 = 117 kg CH_4/ton of residue (or 2.7379 cf/lb of residue).

Project Emissions

There are no sources of emission which might be attributed to the project activities outside its limits because the project does not generate energy outside. The only emissions will result from the efficiency/availability of the flare, the efficiency of the LFG capturing system and from the energy consumed to operate compressors, burners, lighting the operating site and monitoring equipment as detailed below (EL_{IMP}):

- Capturing System Efficiency - Since there are losses of gas through the skirts of each layer of the landfill, LFG Capturing System efficiency estimated is 70%. Though, Araúna is appraising the financial viability of covering the skirts of the landfill to undermine those losses.

- FE

  Flare availability (the percentage of the time that the flare is destroying the methane) estimated as (recommended by manufacturer): 96%

  Flare Efficiency (the percentage of the methane destroyed by the flare) estimated as (recommended by manufacturer): 98% - Will be monitored and calculated as defined by the "Tool to determine project emissions from flaring gases containing methane" during the project activity.

- The calculation of emission factor due to energy consumption from the public grid is in accordance with ACM0002 methodology and is developed as follows:

  Initially is relevant to identify the grid that will supply EABLGP. In Brazil there is a grid responsible for the South-Southeast-Middle West country regions supply. That is the grid considered on the following due to EABLGP location:

  Simple Adjusted Operating Margin Emission Factor

  According to the methodology the next equation shall be resolved to obtain $EF_{OM, simple adjusted, y}$.

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

Assumption: All emissions from low-cost/must run resources are zero.

$$\frac{\sum_{i.,k} F_{i,k,y}\cdot COEF_{i,k}}{\sum_k GEN_{k,y}} = 0 \quad (2)$$

Data was obtained from the following sources:

- Agência Nacional de Energia Elétrica. *Banco de Informações da Geração* (http://www.aneel.gov.br/, data collected in november 2004).
- Bosi, M., A. Laurence, P. Maldonado, R. Schaeffer, A. F. Simoes, H. Winkler and J.-M. Lukamba. *Road testing baselines for greenhouse gas mitigation projects in the electric power sector.* OECD and IEA information paper, October 2002.
- Intergovernamental Panel on Climate Change. *Revised 1996 Guidelines for National Greenhouse Gas Inventories.*
- Operador Nacional do Sistema Elétrico. Centro Nacional de Operação do Sistema. *Acompanhamento Diário da Operação do SIN* (daily reports from Jan. 1, 2002 to Dec. 31, 2004).
- 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).
- Centrais Elétricas Brasileiras S/A. Plano anual de combustíveis - Sistema interligado S/SE/CO 2005 (released December 2004).

Above sources was used to generate the following factors for 2002, 2003 and 2004 using equation (1):

$EF_{OM,\ 2002}$= 0.8504 tCO_2e/ MWh

$EF_{OM,\ 2003}$= 0.9378 tCO_2e/ MWh

$EF_{OM,\ 2004}$= 0.8726 tCO_2e/ MWh

Adjust Factor λ_y:

λ_{2002}= 0.5053

λ_{2003}= 0.5312

λ_{2004}= 0.5041

$EF_{OM,\ simple\_adjusted\ 2002}$= 0.4207 tCO_2e/ MWh

$EF_{OM,\ simple\_adjusted\ 2003}$= 0.4396 tCO_2e/ MWh

$EF_{OM, simple\_adjusted\ 2004}$= 0.4327 tCO_2e/ MWh

The Operating Emission Factor is calculated as the average of $EF_{OM, simple\_adjusted}$ from each year:

$EF_{OM, simple\_ajusted2002-\ 2004}$ = 0.4310 tCO_2e/ MWh

Building Margin

There are two ways to calculate the Building Margin factor (EF_{MB}) described on ACM0002 methodology. The first option was chosen, where the capacity of the most recent build resources responsible for 20% of the system generation is used on the adequate equation (3), for *ex ante* calculation.

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \quad (3)$$

Using the same sources detailed on "Simple Adjusted Operating Margin Emission Factor", EF_{BM} is:

$EF_{BM,\ 2004}$ = 0.0962 tCO_2e/MWh

Combined Margin

The factor calculated above shall compose the final factor $EF_{electricity}$, as follows:

$EF_{electricity} = w_{OM} \,.\, EF_{OM,\ y} + w_{BM} \,.\, EF_{BM,\ y}$

Where:

$w_{OM} = w_{BM} = 0.5(50\%)$ as described by ACM0002 methodology.

$EF_{electricity}$= 0.2636 tCO_2e/MWh

CO_2e generated by the additional energy utilization from EABLGP.

The estimated power increase on the landfill considers the pumps and light utilization increase. The power increase is estimated in 30 KW.

Consumption per year: 30 KW x 8760 hours = 262.8 MWh

CO_2 equivalent per year: 262.8 MWh x 0.2636 tCO_2e/MWh = 69.27 tCO_2e which leads approximately to 70 tCO_2e per year

Total in 7 Years: 490 tCO_2e

Those 490 tCO_2e shall be subtracted from the emission reductions generated by the project activity due to the increase of energy utilization on Bragança landfill boundaries.

Conclusion of *Ex-ante* calculation :

Project Parameters	
Year when operation started	1990
Year when flaring started	2008
Lo(kg CH4/ton of residue)	117
k(1/year)	0,1
GWP(CH4)	21
w (% of methane in LFG)	50%
Gas capture efficiency	70%
Flare efficiency (*ex-ante estimation*)	98%
Flare Availability (*ex-ante estimation*)	96%
EAF	10%
Energy Consumption (MWh/year)	262,8
Emission Factor (Grid energy utilization) (tCO_2/MWh)	0,2636
Total waste from 1990 to 2013 (tons)	1.298.125
Average waste/year from 1990 to 2013 (tons)	54.089

As required by the methodology the next equation concludes the estimation of methane destruction on the flare, only system considered on this Project:

$$MD_{project,y} = MD_{flared,y} = (LFG_{flared,y} \cdot w_{CH_4} \cdot D_{CH_4}) - (PE_{flare,y} / GWP_{CH_4})$$

$MD_{flared,y} =$ Quantity of methane destroyed by flaring

$LFG_{flared,y} =$ Volume o landfill gas flared

$w_{CH_4,y} =$ The average methane fraction of the landfill gas

$D_{CH_4} =$ Methane density

$PE_{flare,y}$ - Project emissions from Flaring of the residual gas stream in year y (tCO_2e)

From the quantity of methane destroyed($MD_{flared,y}$), the emission reduction in tCO_2e was obtained using the GWP_{CH4}=21 given by the methodology.

$$ER_Y = (MD_{project,y} - MD_{reg,y}) \cdot GWP_{CH4} + EL_y \cdot CEF_{electricitry} - ET_y \cdot CEF_{termal}$$

ER_Y - Emission reduction in a given year “y”, in tones of CO_2 equivalent (tCO_2e);

$MD_{project,y}$ - The amount of methane that would have been destroyed/combusted by the project activity during the year, in tones of methane (tCH_4);

$MD_{reg,y}$ - the amount of methane that would have been destroyed/combusted during the year in the absence of the project, in, tones of methane (tCH_4);

GWP_{CH4} - Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4;

EL_y - Net quantity of electricity exported during year y, in megawatt hours (MWh);

$CEF_{electricitry}$ - CO_2 emissions intensity of the electricity displaced, in tCO_2e/MWh. This can estimated using either ACM0002 or AMSI.D, if the capacity is within the small scale threshold values, when grid electricity is used or displaced;

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, in TJ;

CEF_{termal} - CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy, in tCO_2e/TJ.

For the 7 years:

$MD_{project}$ = 516.924 tCO_2e
MD_{reg} = 51.643 tCO_2e
GWP_{CH_4} = 21
EL = EL_{IMP} = -262.8 MWh x 7 years
$CF_{electricity}$ = 0,2677 tCO_2e/MWh
ET_y = 0

So the estimated *ex-ante* Emission Reductions are ER_{7years} = 464.791 tCO_2e

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

Estimation of project activity emissions (tones of CO_2e) – Includes:

- 30% inefficiency on the landfill gas capturing system;
- 2% inefficiency of the enclosed flare;
- 4% unavailability of the flaring system and
- 490 tCO2e of Emissions due to electricity consumption.

Estimation of baseline emissions (tones of CO_2e) – Includes:

- 90% of the total emission estimated through the FOD method(detailed on B.6.3 item) due to AF(10%).

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of overall emission reductions (tonnes of CO_2e)
2008	**45.466**	**111,474**	**-**	**66.008**
2009	**45.493**	**111,540**	**-**	**66.047**
2010	**45.560**	**111,706**	**-**	**66.145**
2011	**45.665**	**111,964**	**-**	**66.298**
2012	**45.805**	**112,306**	**-**	**66.501**
2013	**45.976**	**112,725**	**-**	**66.750**
2014	**46.176**	**113,216**	**-**	**67.041**
Total (tonnes of CO_2e)	**320.140**	**784,931**	**-**	**464.791**

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**$LFG_{total,y}$ - $FV_{RG,h}$**
Data unit:	m3(cubic meters)
Description:	Volume of landfill gas captured and flared
Source of data to be used:	Flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Very important
Description of measurement methods and procedures to be applied:	➢ The flow of landfill gas will be measured right before the flare, avoiding the measurement of landfill gas that might leak. ➢ There is a Low level of uncertainty on this type of equipment which is quite common on the industry and quite accurate. Even so, the flow meter will be calibrated once a year. ➢ All the data will be recorded continuously, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.

QA/QC procedures to be applied:	Flow meters will be subjected to a regular maintenance and testing regime to ensure accuracy.
Any comment:	As there is no other system that uses landfill gas that will claim CERs, such as boiler or generator, the only flow meter will be the one on the flare system.

Data / Parameter:	$W_{CH4,y}$
Data unit:	% (Percentage) - m^3 CH_4/ m^3 LFG
Description:	Methane fraction in the landfill gas
Source of data to be used:	LFG analysis
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	➢ The Methane fraction on the LFG gas will be measured continuously. ➢ There is a Low level of uncertainty on this type of equipment. Even so, the gas analyzer will be calibrated once a year. ➢ All the data will be recorded continuously, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.
QA/QC procedures to be applied:	Gas Analyzer will be subjected to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

Data / Parameter:	$T_{Landfill\ gas}$
Data unit:	^oC (Celsius)
Description:	Temperature
Source of data to be used:	Thermometers
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	➢ The Temperature of the LFG gas will be measured continuously. ➢ There is a Low level of uncertainty on this type of equipment. Even so, the thermometer will be calibrated once a year. ➢ All the data will be recorded continuously, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.
QA/QC procedures to be applied:	
Any comment:	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.

Data / Parameter:	**P**
Data unit:	Pa (Pascal)
Description:	Pressure of the landfill gas

Source of data to be used:	Manometer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	➢ The Pressure of the LFG gas will be measured continuously. ➢ There is a Low level of uncertainty on this type of equipment. Even so, the manometer will be calibrated once a year. ➢ All the data will be recorded continuously, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.
QA/QC procedures to be applied:	
Any comment:	Measured to determine the density of methane D_{CH4}. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.

Data / Parameter:	**EL_{IMP}**
Data unit:	MWh
Description:	Total amount of electricity imported to meet project requirement.
Source of data to be used:	Electricity consumption measurer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Relevant
Description of measurement methods and procedures to be applied:	➢ The additional Electricity imported for the project will be measured continuously. ➢ There is a Low level of uncertainty on this type of equipment. Even so, the electricity measurer will be calibrated once a year. There will be a separated electrical system from the landfill, allowing the monitoring of the precise additional use of electricity. ➢ All the data will be recorded continuously, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**$CEF_{electricity, y}$**
Data unit:	tCO_2e/MWh
Description:	CO_2 emission intensity of the electricity and/or other energy carriers in ID 9.

Source of data to be used:	Information from the grid responsible groups in Brazil
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Important, since it represents approximately 0.055% of the estimated emission reductions.
Description of measurement methods and procedures to be applied:	➢ New data from the electric grid will be consider to review the CO_2 emission intensity of the electricity
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**Regulatory requirements relating to landfill gas projects**
Data unit:	Text
Description:	Regulatory requirements relating to landfill gas projects
Source of data to be used:	Laws
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	➢ The Regulatory requirements for landfills will be assessed yearly. ➢ All the data will be recorded yearly, on an electronic database. ➢ The responsible person/entity will be defined on the project verification.
QA/QC procedures to be applied:	
Any comment:	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly MDreg,y at renewal of the credit period.

Regarding Flare efficiency, according to "Tool to determine project emissions from flaring gases containing methane"

Data / Parameter:	**$Vf_{i,h}$**
Data unit:	-
Description:	Volumetric fraction of component *I* in the residual gas in the hour *h* where *i*= CO_2, CO, O_2, H_2, N_2 and CH_4 (already considered as $\mathbf{W_{CH4,y}}$, above)
Source of data to be used:	Measurements by project participants using a continuous gas analyser
Value of data applied for the purpose of calculating expected emission reductions in	Important

section B.5	
Description of measurement methods and procedures to be applied:	Ensure that the same basis (dry or wet) is considered for this measurement and the measurement of the volumetric flow rate of the residual gas (FVRG,h) when the residual gas temperature exceeds 60 ºC Frequency: Continuously. Values to be averaged hourly or at a shorter time interval
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard certified gas.
Any comment:	As a simplified approach, project participants may only measure the methane content of the residual gas and consider the remaining part as N2.

Data / Parameter:	$t_{O2,h}$
Data unit:	-
Description:	Volumetric fraction of O2 in the exhaust gas of the flare in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	Extractive sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes). Frequency: Continuously. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to the manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas.
Any comment:	

Data / Parameter:	$fv_{CH4,FG,h}$
Data unit:	mg/m3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Source of data to be used:	Measurements by project participants using a continuous gas analyzer
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of	Extractive sampling analyzers with water and particulates removal devices or in situ

measurement methods and procedures to be applied:	analyzer for wet basis determination. The point of measurement (sampling point) shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperatures level (e.g. inconel probes). Frequency: Continuously. Values to be averaged hourly or at a shorter time interval.
QA/QC procedures to be applied:	Analyzers must be periodically calibrated according to manufacturer's recommendation. A zero check and a typical value check should be performed by comparison with a standard gas.
Any comment:	Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m^3 simply multiply by 0.716. 1% equals 10 000 ppmv.

Data / Parameter:	T_{flare}
Data unit:	^oC
Description:	Temperature on the exhaust gas of the flare
Source of data to be used:	Measurements by project participants
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Important
Description of measurement methods and procedures to be applied:	Measure the temperature of the exhaust gas stream in the flare by a Type N thermocouple. A temperature above 500 ^oC indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures to be applied:	Thermocouples replaced or calibrated every year
Any comment:	

B.7.2 Description of the monitoring plan:

The actions of quality guarantee that will be implemented in the context of the Bragança Project are the following:

Process planning: an implantation and operation process planning for the Bragança Project will be elaborated, in which the following will be defined: objectives and goals of the Project and its respective deadlines, attributions and responsibilities of the technical personnel involved directly or indirectly in the services, system for document and process registering control, system for communication with the other prospects, system for controlling of the operation and the measuring and monitoring devices, maintenance of equipment, quality auditing, parameters of the monitoring process and operation, analysis of the collected data, system for the making of corrective actions, preventive actions and process improvement actions.

Maintenance Plan: A Maintenance Plan will be elaborated, aiming at obtaining the maximum performance and regularity of the system operation, covering at least the following aspects: frequency of equipment preventive maintenance, maintenance procedures detailed according to technical specifications of the equipment manufacturers, when applicable; frequency of equipment calibration, specially of those responsible for the measurement of data to be monitored and routines of periodical check ups to verify the functioning and performance of the equipment.

Documents of quality: documents will be elaborated containing instructions for the execution of the main activities attributed to the involved technical personnel of Bragança landfill, to guarantee that they will be done in conformity to the specified requirements.

Process Register: the registers to be generated will be defined for the variables of the process to be monitored already indicated, as well as to confirm the proceeding of the control activities and quality guarantee, in a way that allows the tracking of the process in any moment of the Project. For each register a system of identification, periodicity of capture/detection, storage, protection, recovery, retention and disposing time will be defined, when applicable.

Register of Field Monitoring: The monitoring of the variables of the process indicated previously will be continuously carried out in order to ensure the follow up of its behavior in time, allowing the verification of any anomalies in the process and the beginning of correctional and/or preventive actions in due time to eliminate its causes. At first these registers will be gathered "in loco" and written down in spread sheets or through telemetry equipment and digitally stored in the form of data bank with access determined by a granting policy.

Calibration of the measurement equipment: The calibration of the measurement equipment and/or monitoring will be done periodically, according to the requirements of INMETRO (Metrology National Institute), norms applied to ABNT and the precision requirements established in the used equipment Maintenance Plan. Whenever applicable, the calibration will be carried out by qualified companies/entities with recognized experience in the market in this activity, using methods and instruments traceable to international standards of quality..

Periodical Inspection: Inspections will be carried out by the responsible ones in the involved technical team, related to the: accompaniment of the operation; inspection of the equipment and analysis of the data collected and indexes of maintenance and regularity of the functioning of the equipment. Eventual unsolved matters that are detected will be registered for the proper action taking, including corrective maintenance, whenever necessary.

Unsolved task warning: Following the checkup, a "unsolved task warning" is sent to the technical staff of the place, listing all the tasks considered necessary by the managing team. This is verified in the subsequent checkups to secure that these tasks were carried out. Registers of these checkups will be filed, as well as the items and services verified.

Quality auditing: Teams formed by capable technical staff that are not directly involved in the Project will conduct quality audits with the purpose of evaluate the adequacy of the operation being carried out in relation to the previously elaborated planning.
The resulting observations of eventual deviations will be reported and sent to the responsible people for the proper actions, so that they can be solved in the shortest possible time.

Corrective, Preventive and Improvement Actions: The quality guarantee measures include procedures for treating and correcting non-conformities in the implementation of the Project and in the operation and maintenance of the System. If such non-conformities are detected, specially those related to the corrective maintenance of the equipment:

- An analysis of the non-conformity and its causes will be conducted immediately by the Bragança landfill staff;

- The Bragança landfill administration will make a decision about the corrective actions adequate to eliminate the non-conformity and its causes;

- Corrective actions are implemented and reported to the Bragança landfill administration.

If non-conformities that might occur are detected, a similar procedure will be adopted on Preventive Action taking and register.

On the other hand, improvements that might be incorporated in the process will be registered and followed through Improvement Actions.

All these actions will be guided to the accomplishment of the objectives and goals established in the service planning.

Besides the quality guarantee measures described above, the Bragança landfill team will prepare a Operation Manual that will include procedures for training, capacitating, providing and adequate treatment of the equipment, infra-structure and working environment, emergency and safety at work plans. The Bragança landfill team will also guarantee the provision of human and material resources predicted in the service planning and necessary for the accomplishment of the activities, so that all the professionals involved will receive adequate training about the implementation of this Monitoring and Project Plan.

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

Date of completion of this section of the baseline and monitoring

- 31/10/2005

Name of the person/entity that determines the baseline

- Green Domus Desenvolvimento Sustentável Ltda..
  Rua Nova Orleans, 297 – Brooklin Novo – São Paulo, SP – Brazil – CEP 04561-030
  Responsible: André Leonel Leal
  e-mail: andrell@greendomus.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:

- 01/10/2006

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

- 21 years and 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:

- 01/01/2008

C.2.1.2. Length of the first crediting period:

- 7 years and 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. Environmental impacts

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

The Bragança landfill working and installations are in fully accordance with Sao Paulo state legislation referent. See following licenses

Licenses list:

- Installation License
  # 000783 – Process # 05/01079/91 – Date 19/09/1995 (dd/mm/yyyy).

- Working License
  # 000675 – Process # 05/01079/91 – Date 18/12/1997 (dd/mm/yyyy).

See Annex 5.

Therefore environmental impacts which are landfill responsibility are in compliance with regulatory requirements to sanitary landfill respecting environmental requirements within the proper law.

The burning system considered on this project allows GHG emissions reduction. Beside the methane, considered by EABLGP, there are others gases, which are not quantified on this document, such as sulphur dioxide and volatile organic compounds which will be burned as well. The result will be emission reduction of other GHG emissions besides the methane.

The increase of grid electricity utilization will generate a negative environmental impact, however, that impact have been quantified and discounted from the GHG emission reduction generated by this project. The increase of electricity utilization represents approximately 0.125% of the total emissions reduction of the project activity.

The LFG capture and flaring reduce the risks of explosion due to spontaneous combustion on the landfill. This can be classified as a risk mitigation of a negative environment impact as it reduces this event probability.

LFG flaring also reduce in a significant way the impact of odors which are especially relevant for landfill neighborhoods.

To reduce GHG emissions, explosion risks and odors are positive environmental impacts which are added to social and economic factor, also present on this project, contributing to sustainable development.

The environment license for the project will be obtained after the construction of the capturing and flaring systems.

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:

From all environmental impacts evaluated, no negative impacts were considered relevant.

SECTION E. Stakeholders' comments

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

According to the Resolution 1 of Brazilians DNA "Comissão Interministerial de Mudança Global do Clima", issued in December 2nd 2003, the decree from July 7th 1999, invitations to comment on the project will be sent to entities listed in Article 3 item II on the referred resolution and, additionally, to other entities to which the subject could interest, allowing commenting on the project. Follows the list of entities invited to comment:

- **Prefeitura Municipal da Estância de Bragança Paulista**
  Dr JOÃO AFONSO SÓLIS
  Prefeito Municipal
  Av Antonio Pires Pimentel, 2015 – Centro
  12914-001 Bragança Paulista SP

- **Prefeitura Municipal da Estância de Bragança Paulista**
  JOÃO CARLOS MONTE CLARO VASCONCELLOS
  Vice-Prefeito Municipal
  Av Antonio Pires Pimentel, 2015 – Centro
  12914-001 Bragança Paulista SP

- **Secretaria Municipal de Obras e Meio Ambiente da Prefeitura Municipal da Estância de Bragança Paulista**
  MIGUEL RIBEIRO DA SILVA
  Secretário
  Av Antonio Pires Pimentel, 2015 – Centro
  12914-001 Bragança Paulista SP

- **Câmara Municipal da Estância de Bragança Paulista**
  CLÓVIS AMARAL GARCIA
  Presidente da Câmara Municipal da Estância de Bragança Paulista
  Pça Hafiz Abi Chedid, 125 – Jd América
  12902-900 Bragança Paulista SP

- **Ministério Público de Bragança Paulista – Promotoria de Justiça**
  Dra. KELLY CRISTINA ALVAREZ FEDEL
  Promotora de Justiça do Meio Ambiente de Bragança Paulista
  Av. dos Imigrantes, 1501 – Jd América
  12902-000 Bragança Paulista SP

- **Associação Bragança Mais**
  HELOÍSA DE LÓCIO E SILVA STEFANI
  Presidente do Projeto Bragança Mais
  Rua Cel. Leme, 205 – Centro
  12900-340 Bragança Paulista SP

- **Grupo Eco de Bragança Paulista**
  DOMINGOS BERNARDI NETO
  Presidente do Grupo Eco de Bragança Paulista
  Rua Cel Teófilo Leme, 1528
  12900-002 Bragança Paulista SP

- **Bragança Jornal Diário**
  OMAIR FAGUNDES DE OLIVEIRA
  Diretor
  Av. Antonio Pires Pimentel, 957 - Centro
  12914-000 Bragança Paulista SP

- **Jornal da Cidade**
  ANTONIO CARLOS VIDIRI
  Diretor
  Rua Dr. Cândido Rodrigues, 44 sala 09 – Centro
  12900-360 Bragança Paulista SP

- **Jornal em Dia**
  JOSÉ CARLOS RODRIGUES CASTILHO
  Diretor
  Rua João Franco, 944 - Cruzeiro
  12906-000 Bragança Paulista SP

- **Jornal Cidade de Bragança**
  PAULO E. DE OLIVEIRA e ARACY PAYÃO LUCAS
  Diretores Responsáveis
  Av. Antonio Pires Pimentel, 957, sala 02 – Centro
  12914-000 Bragança Paulista SP

- **Gazeta Bragantina**
  PAULO ALBERTI DA SILVA FILHO
  Diretor
  Rua São Pedro, 246 - Jd Primavera
  12900-000 Bragança Paulista SP

- **Secretaria do Meio Ambiente do Estado de São Paulo**
  DR. JOSÉ GOLDENBERG
  Secretário
  Av. Prof. Frederico Hermann Jr., 345
  São Paulo – SP
  05459-900

- **Companhia de Tecnologia e Saneamento Ambiental - CETESB**
  DR. RUBENS LARA
  Presidente
  Av. Prof. Frederico Hermann Jr., 345
  São Paulo – SP
  05459-900

- **Secretaria de Estado da Saúde**
  DR. LUIZ ROBERTO BARRADA BARATA
  Secretário
  Av. Dr. Enéas de carvalho Aguiar, 188
  São Paulo – SP
  05403-000

- **Fórum Brasileiro de ONG's e Movimentos Sociais para o Meio Ambiente e Desenvolvimento**
  Coordenação Nacional
  SCLN 210 – Bloco C – Sala 102
  Brasília – DF

70856-530

Registered Letters were sent on November 3rd of 2005. Responses were received before December 3rd and are considered on G.2 summary. Detailed letter reference and complete stakeholders comments Are available for consultation on www.greendomus.com.

E.2. Summary of the comments received:

Were received comments from:

- Câmara Municipal da Estância de Bragança Paulista
- Secretaria do Estado da Saúde

Both were favorable to the project.

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

As the comments received are favorable to the project no changes or considerations were needed on the PDD.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Embralixo - Empresa Bragantina de Varrição e Coleta de Lixo Ltda
Street/P.O.Box:	Rua Tupi, nº 140, Bairro do Taboão
Building:	
City:	Bragança Paulista
State/Region:	São Paulo
Postfix/ZIP:	12900-000
Country:	Brasil
Telephone:	55 11 4031-5000
FAX:	55 11 4031-5500
E-Mail:	n.sfatima@uol.com.br
URL:	
Represented by:	Owner
Title:	Director
Salutation:	Mr.
Last Name:	Rodrigues
Middle Name:	José
First Name:	Manuel
Department:	
Mobile:	
Direct FAX:	55 11 4031-5500
Direct tel:	55 11 4031-5000
Personal E-Mail:	

Organization:	Araúna Participações e Investimentos Ltda
Street/P.O.Box:	Al. Jaú, 1742 - cj. 11
Building:	Edifício Armando Petrella
City:	São Paulo
State/Region:	São Paulo
Postfix/ZIP:	01420-002
Country:	Brasil
Telephone:	55 11 3894 33 11
FAX:	55 11 3849 33 11
E-Mail:	grupoarauna@grupoarauna.com.br
URL:	www.grupoarauna.com.br
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Maruca
Middle Name:	Roberto
First Name:	Mauricio
Department:	Board of Directors
Mobile:	

Direct FAX:	55 11 3894 33 11
Direct tel:	55 11 3894 33 11
Personal E-Mail:	maruca@grupoarauna.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There are no public financing for the project.

Annex 3

BASELINE INFORMATION

Project Parameters	
Year when operation started	1990
Year when flaring started	2008
Lo(kg CH4/ton of residue)	117
k(1/year)	0,1
GWP(CH4)	21
w (% of methane in LFG)	50%
Gas capture efficiency	70%
Flare efficiency (ex-ante estimation)	98%
Flare Availability (ex-ante estimation)	96%
EAF	10%
Energy Consumption (MWh/year)	262,8
Emission Factor (Grid energy utilization) (tCO_2/MWh)	0,2636
Total waste from 1990 to 2013 (tons)	1.298.125
Average waste/year from 1990 to 2013 (tons)	54.089

	Estimated Emissions without the project activity		Estimated Total Project Emission					Estimated Project Emission Reduction
			LFG capture Inefficiency (30%)	Flare Inefficieny (2%)	Flare Unavailability (4%)	Emissions due to electricity consumption	EAF 10%	
Year	Cubic Meters CH_4	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
1st	7.405.558	111.474	33.442	1.561	3.059	70	7.334	66.008
2nd	7.409.902	111.540	33.462	1.562	3.061	70	7.339	66.047
3rd	7.420.923	111.706	33.512	1.564	3.065	70	7.349	66.145
4th	7.438.058	111.964	33.589	1.567	3.072	70	7.366	66.298
5th	7.460.794	112.306	33.692	1.572	3.082	70	7.389	66.501
6th	7.488.673	112.725	33.818	1.578	3.093	70	7.417	66.750
7th	7.521.278	113.216	33.965	1.585	3.107	70	7.449	67.041
Total in 7 years	52.145.187	784.931	235.479	10.989	21.539	490	51.643	464.791
Annual average	7.449.312	112.133	33.640	1.570	3.077	70	7.378	66.399

Annex 4

MONITORING INFORMATION

Approved consolidated monitoring methodology **ACM0001**
"Consolidated monitoring methodology for landfill gas project activities"

Applicability
This methodology is applicable to landfill gas capture project activities, where the baseline scenario is the partial or total atmospheric release of the gas and the project activities include situations such as:

a) The captured gas is flared; or

b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources (1); or

c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable". If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54 TJ (15GWh), small-scale methodologies can be used.

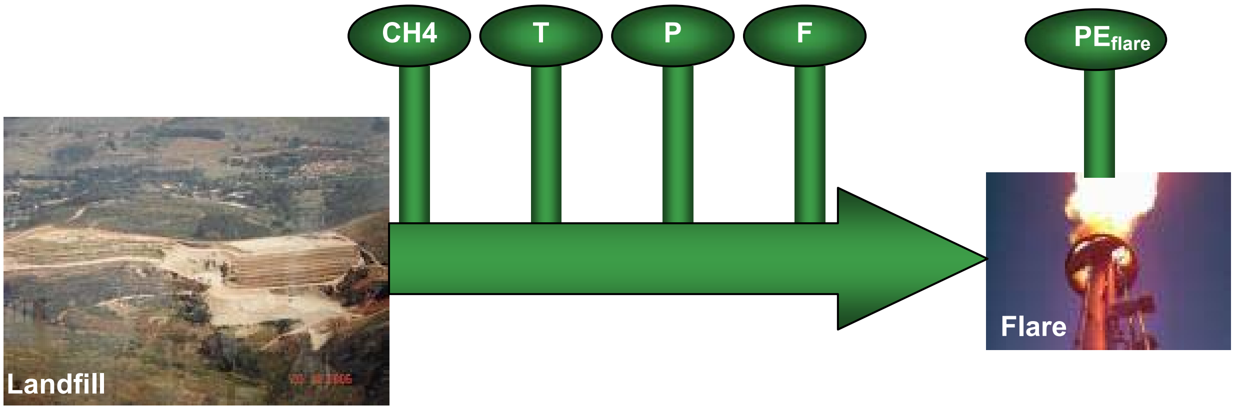
(1) Although in this case no emission reductions are claimed for displacing or avoiding energy from other sources, all possible financial revenues and/or emission leakages shall be taken into account in all the analyses performed.

This monitoring methodology shall be used in conjunction with the approved baseline methodology ACM0001 ("Consolidated baseline methodology for landfill gas project activities").

Monitoring Methodology

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare platform and the electricity generating/thermal energy unit(s) to determine the quantities as shown in Figure 1. The monitoring plan provides for continuous measurement of the quantity and quality of LFG flared. The main variables that need to be determined are the quantity of methane actually captured $MD_{project,y}$, quantity of methane flared ($MD_{flared,y}$) and the quantity of methane used to generate electricity ($MD_{electricity,y}$)/thermal energy ($MD_{thermal,y}$).

Figure - Monitoring Plan – Illustrative Pictures



CH_4 - **Fraction of Methane**

T - **Temperature**

P - **Pressure**

F - **Flow of LFG**

PE_{flare} - **Flare emissions from flaring of the residual stream**

To determine these variables, the following parameters have to be monitored:

- The amount of landfill gas generated (in m³, using a continuous flow meter), where the total quantity ($LFG_{total,y}$) as well as the quantities fed to the flare ($LFG_{flare,y}$), to the power plant ($LFG_{electricity,y}$) and to the boiler ($LFG_{thermal,y}$) are measured continuously. For $LFG_{electricity,y}$ and to the boiler $LFG_{thermal,y}$, .

- The fraction of methane in the landfill gas ($w_{CH4,y}$) should be measured with a continuous analyzer or, alternatively, with periodical measurements, at a 95% confidence level , using calibrated portable gas meters and taking a statistically valid number of samples and accordingly the amount of land fill gas from $LFG_{total,y}$, $LFG_{flare,y}$, $LFG_{electricity,y}$, and $LFG_{thermal,y}$ shall be monitored in the same frequency. The continuous methane analyzer should be the preferred option because the methane content of landfill gas captured can vary by more than 20% during a single day due to gas capture network conditions (dilution with air at wellheads, leakage on pipes, etc.).

- The parameters used for determining the project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) should be monitored as per the "Tool to determine project emissions from flaring gases containing Methane".

- Temperature (T) and pressure (p) of the landfill gas are required to determine the density of methane in the landfill gas.

- The quantities of fossil fuels required to operate the landfill gas project, including the pumping equipment for the collection system and energy required to transport heat, should be monitored. In projects where LFG gas is captured in the baseline to either meet regulation or for safety reason, fossil fuel in the baseline too should be recorded.

- Relevant regulations for LFG project activities shall be monitored and updated at renewal of each crediting period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{reg,y}$). Project participants should explain how regulations are translated into that amount of gas.
- The operating hours of the energy plant and the boiler (which will not exist in this case).

The measurement equipment for gas quality (humidity, particulate, etc.) is sensitive, so a strong QA/QC procedure for the calibration of this equipment is needed.

Annex 5

DE : FAX :1150717863 20 OUT. 2005 15:10 Pág.2

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

06

Processo Nº 05/01079/91

LICENÇA DE INSTALAÇÃO

SISTEMA DE DESTINAÇÃO DE RESÍDUOS NO SOLO

Nº 000783

Data 19.09.95

IDENTIFICAÇÃO DA ENTIDADE

Nome: ATERRO SANITÁRIO DE BRAGANÇA PAULISTA - EMBRALIXO - EMPRESA BRAGANTINA DE VARRIÇÃO E COLETA DE LIXO LTDA.

Cadastro na CETESB: 225- 00354-5

Logradouro: Estrada Municipal do Campo Novo

Número: s/nº

Complemento:

Bairro: Campo Novo

CEP: 12900-000

Município: Bragança Paulista

CARACTERÍSTICAS DO PROJETO

Bacia Hidrográfica: 14 - Rio Piracicaba - UGRHI 05

Corpo Receptor: Rio Jaguari

Classe: 2

Área (metro quadrado)

Terreno: 145.224,00

Construção: 50,00

Sistema: 48.575,00

Horário de Funcionamento (h)

Início: 08:00 às Término: 17:00

Nº de Funcionários

Administração: 01

Produção: 02

1ª VIA - ENTIDADE (BRANCA)
2ª VIA - PROCESSO (VERDE)
3ª VIA - SEDE (ROSA)
4ª VIA - EMITENTE (AMARELA)

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, concede a presente licença, nas condições e termos nela constantes;

A presente licença está sendo concedida com base nas informações constantes do Memorial de Caracterização do Empreendimento apresentado pelo interessado e não dispensa nem substitui quaisquer Alvarás ou Certidões de qualquer natureza, exigidas pela legislação federal, estadual ou municipal;

As Exigências Técnicas, parte integrante desta Licença, estão relacionadas no verso ou folha Anexo;

Deverá ser requerida Licença de Funcionamento, antes da data prevista para o início das operações, a qual não será concedida caso não tenham sido atendidas as Exigências Técnicas integrantes desta Licença;

A operação deste empreendimento não poderá ser iniciada sem que a respectiva Licença de Funcionamento seja concedida pela CETESB, sob pena de aplicação das penalidades previstas na legislação pertinente em vigor.

USO DA CETESB

AR ÁGUA SOLO RUÍDO

EMITENTE

Local: Campinas

ENG. HÉLIO CÉSAR NASCIMENTO UNGARI

DE : FAX :1150717863 20 OUT. 2005 15:09 Pág.1

RESÍDUOS PERMITIDOS PARA DESTINAÇÃO

1. Não poderão ser recebidos no aterro resíduos industriais que contenham líquidos livres determinados conforme projeto de Norma ABNT.

2. Não poderão ser recebidos no aterro resíduos industriais classificados como perigosos, bem como, resíduos sólidos de serviço de saúde.

3. Deverá ser apresentado à CETESB relatório de acompanhamento da execução da camada de impermeabilização em argila a qual deverá ter acompanhamento tecnológico devendo a mesma ser executada de modo a alcançar coeficiente de permeabilidade inferior a K 10-7 cm/s tanto no fundo quanto nos taludes;

4. Qualquer ampliação da área do aterro deverá ser objeto de projeto a ser submetido à aprovação da CETESB;

5. A CETESB deverá ser informada com uma antecedência de no mínimo 7 dias a data da implantação das camadas de impermeabilização em argila e dreno de percolados e da execução da cobertura final de modo a permitir o acompanhamento pela CETESB;

6. O monitoramento das águas substerrâneas deverá ser efetuado de acordo com plano aprovado, devendo ter frequência trimestral, e incluir determinação do nível do lençol freático e a análise dos seguintes parâmetros: alcalinidade, arsênio, bário, cádmio, carbono orgânico dissolvido, chumbo, cloretos, DQO, fenóis, ferro, manganês, mercúrio, nitrogênio amoniacal, nitrogênio nitrato, pH, sólidos dissolvidos totais, sulfato e selênio. O monitoramento deverá ser executado nos piezômetros existentes.

7. Deverá ser apresentado relatório anual, até dia 31 de janeiro de cada ano, referente à quantidade, tipo e origem dos resíduos industriais recebidos, resultados do monitoramento das águas subterrâneas e relatório de recirculação de líquidos percolados.

8. Os sistemas de desvio das águas pluviais, de coleta de líquidos percolados e de monitoramento e os acessos deverão ser mantidos em condição de operação durante toda a vida útil do aterro.

9. Deverá ser mantida uma faixa de recuo no entorno de toda área com a implantação de barreira vegetal com espécies de vários portes com 5,0 (cinco) metros de largura.

10. Deverão ser atendidos todos os elementos e especificações constantes do projeto apresentado por ocasião da solicitação da Licença de Instalação, levando em consideração, todas as alterações feitas por exigência da CETESB.

11. Após o encerramento das atividades ora licenciadas a área deverá receber tratamento final de acordo com projeto previamente aprovado pela CETESB.

Observações:

1. A presente Licença está sujeita a renovação nos termos da Lei nº 9477 de 30.12.96 4 seu Regulamento.

DE : FAX :1150717863 20 OUT. 2005 15:07 Pág.1

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

07

Processo Nº 05/01079/91

LICENÇA DE FUNCIONAMENTO

SISTEMA DE DESTINAÇÃO DE RESÍDUOS NO SOLO

№ 000675

Data 18.12.97

IDENTIFICAÇÃO DA ENTIDADE

Nome: ATERRO SANITÁRIO DE BRAGANÇA PAULISTA - EMBRALIXO - EMPRESA BRAGANTINA DE VARRIÇÃO E COLETA DE LIXO LTDA.

Cadastro na CETESB: 225 - 00354 - 5

Logradouro: Estrada Municipal do Campo Novo

Número: –

Complemento: s/nº

Bairro: Campo Novo

CEP: 12900-000

Município: Bragança Paulista

CARACTERÍSTICAS DO PROJETO

Bacia Hidrográfica	Corpo Receptor	Classe
14 Rio Piracicaba	Rio Jaguari	2.

Área (metro quadrado)

Terreno	Construção	Sistema
145.224,00	50,00	48.575,00

Horário de Funcionamento (h)		Número de Funcionários		Licença de Instalação	
Início	Término	Administração	Produção	Data	Número
08:00	às 17:00	01	02	19.09.95	000783

1ª VIA - ENTIDADE (BRANCA)
2ª VIA - PROCESSO (VERDE)
3ª VIA - SERIE (ROSA)
4ª VIA - EMITENTE (AMARELA)

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, concede a presente licença, nas condições e termos nela constantes;

A presente licença está sendo concedida com base nas informações constantes do Memorial de Caracterização do Empreendimento apresentado pelo interessado e não substitui quaisquer Alvarás ou Certidões de qualquer natureza, exigidos pela legislação federal, estadual ou municipal;

A presente licença concede permissão para destinação final dos resíduos relacionados no verso, na área acima identificada para o SISTEMA;

A entidade deverá:

- somente receber resíduos industriais, de entidades geradoras que possuírem Certificado de Aprovação de Destinação de Resíduos Industriais, indicando-a como local de destino;
- ~~[illegible] CETESB [illegible] recebimento de resíduos perigosos~~
- registrar todo resíduo recebido, indicando tipo, quantidade e seção do sistema utilizada para destinação;
- remeter, até o último dia de janeiro de cada ano, relatório à CETESB, informando tipos, quantidades e origens dos resíduos perigosos recebidos durante o exercício fiscal anterior, e dados obtidos da rede de monitoramento;
- sanar, em caráter de urgência, problemas de poluição causados no recebimento dos resíduos industriais.

Alterações nas atuais atividades deverão ser precedidas de Licença de Instalação.

EMITENTE

Local: Campinas

0295/07

ENG. HELIO CESAR NASCIMENTO UNGARI
Gerente da Agência Ambiental de Campinas

DE : FAX :1150717863 31 OUT. 2005 11:53 Pág. 1

EXIGÊNCIAS TÉCNICAS

1. Não poderão ser recebidos no aterro resíduos industriais que contenham líquidos livres determinados conforme projeto de Norma ABNT

2. Somente poderão ser recebidos resíduos industriais cuja destinação no aterro tenha sido analisada e aprovada pela CETESB, devidamente acompanhados do CADRI, devendo ser mantido registro do recebimento dos mesmos;

3. Não poderão ser recebidos no aterro resíduos industriais classificados como perigosos;

4. Deverá ser apresentado à CETESB relatório de acompanhamento da execução da camada de impermeabilização em argila a qual deverá ter acompanhamento tecnológico devendo a mesma ser executada de modo a alcançar coeficiente de permeabilidade inferior a K 10-7 cm/s tanto no fundo quanto nos taludes;

5. Qualquer ampliação da área do aterro deverá ser objeto de projeto a ser submetido à aprovação da CETESB;

6. A CETESB deverá ser informada com uma antecedência de no mínimo 7 dias a data da implantação das camadas de impermeabilização em argila e dreno de percolados, elementos enterrados do sistema de coleta de percolados e da execução da cobertura final de modo a permitir o acompanhamento pela CETESB;

7. O monitoramento das águas subterrâneas deverá ser efetuado de acordo com plano aprovado, devendo ter frequência trimestral, e incluir determinação do nível do lençol freático e a análise dos seguintes parâmetros: alcalinidade, arsênio, bário, cádmio, carbono orgânico dissolvido, chumbo, cloretos, DQO, fenóis, ferro, manganês, mercúrio, nitrogênio amoniacal, nitrogênio nitrato, pH, sólidos dissolvidos totais, sulfato e selênio. O monitoramento deverá ser executado nos piezômetros existentes e no poço próximo à edificação na entrada do aterro.

8. Deverá ser apresentado relatório anual, até dia 31 de janeiro, referente a quantidade, tipo e origem dos resíduos industriais recebidos, resultados do monitoramento das águas subterrâneas e relatório de recirculação de líquidos percolados.

9. Os sistemas de desvio das águas pluviais, de coleta de líquidos percolados e de monitoramento e os acessos deverão ser mantidos em condição de operação durante toda a vida útil do aterro;

10. Deverá ser mantida uma faixa de recuo no entorno de toda área com a implantação de barreira vegetal com espécies de vários portes com 5,0 (cinco) metros de largura.

11. Deverão ser atendidos todos os elementos e especificações constantes do projeto apresentado por ocasião desta, levando em consideração, todas as alterações feitas por exigência da CETESB.