SALVADOR DE BAHIA LANDFILL GAS MANAGEMENT PROJECT

BRAZIL

PROJECT DESIGN DOCUMENT (PDD)

Version 5

March 2005

Version number	date	changes
Version 4	October 2003	General : Adaptation to edited version of AM0002
Version 5	March 2005	1 – page 2 : insertion of table of revisions 2 – section A3 and Annex 1: modification of project participants 3 – change of company name “Vega Bahia Tratamento de Residuos S.A.” to “ BATTRE : Bahia Transferencia e Tratamento de Residuos S.A.” 4 – Adaptation to current PDD model (July 2004)

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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>>
Salvador da Bahia Landfill Gas Management Project.

A.2. Description of the project activity:

>>
The Project activity involves installing equipment to improve efficiency of methane capture and destruction, with capacity of 6,250 m^3/h in 2000 (expanding to 46,250 m^3/h in 2020). This equipment will consist of enclosed flaring with controlled burning condition.

The Project is also designed to increase the waste disposal volume by optimising the waste decomposition over time (thereby increasing the landfill lifetime and postponing the necessity of a new landfill in another area).

The project would make a strong contribution to sustainable development in Brazil. Over and above reducing emissions of GHGs, there are other strong merits related to sustainable development. The project is consistent with criteria that are mentioned in a discussion paper dated April 2002 on performance metrics for sustainable development for CDM projects in Brazil published by the Ministerio do Meio Ambiente (source: Ministerio do Meio Ambiente 2002, "*Criterios de Elegibilidade e Indicadores de Sustentabilidade para Avaliacao de Projetos que Contribuam para a Mitigacao das Mundancas Climaticas e para a Promocao do Desenvolvimento Sustentavel*."). The project, for example, would demonstrate the application of a world-class methane capture system in Brazil. Furthermore, BATTRE (Formerly VEGA) has also proposed to voluntarily allocate 5% of value from net proceeds from sale of GHG emission reduction units to activities that would benefit the local community, environment, and economy. Like its parent company SUEZ, BATTRE (formerly VEGA) has a strong past record of demonstrating corporate social responsibility through such initiatives and sees this project as another opportunity to illustrate the benefits of such activities. In the past, BATTRE (formerly VEGA) has contributed to the local community by financing a capacity-building course for young scavengers from Salvador City and part of the construction of a sorting centre (operated by 80 ex-scavengers now organised as an independent co-operative). It would seek to build on these initiatives.

An additional key element of the contribution to sustainable development is the option that the project will provide to subsequently install landfill gas to energy (LFGTE) equipment that could produce electricity on the schedule shown in Table 1. As mentioned above, although the LFGTE element of the project might be eligible for CERs, it is being excluded from the calculation of CERs because its timing is uncertain, to make the project calculation more straightforward, and to use the most conservative baseline possible. Substitution of fossil fuel-based electricity by electricity generated from renewable sources is, however, another potential sustainable development benefit of the project.

Table 1: Potential Installation of Capacity and Estimated Electricity Production

Year	*Installed Power*	*Annual electricity production (MWh)*
2004-2005	*8 MW*	*63,000*
2006-2008	*16 MW*	*126,000*
2009-2013	*24 MW*	*189,000*
2014-2018	*32 MW*	*252,000*
2019-...	*40 MW*	*315,000*

A.3. Project participants:

>>

Project Developers: **BATTRE Bahia Transferencia e Tratamento de Residuos S.A., (project sponsor)**

Annex I Project participants:

Showa Shell Sekiyu K.K. (Japan)
Shell Trading International Limited (UK)

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>>

A.4.1.1. Host Party(ies):

>>

Brazil

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

>>

Bahia State

A.4.1.3. City/Town/Community etc:

>>

Salvador municipality

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

>>

The Salvador da Bahia landfill, known more correctly as Aterro Metropolitano do Centro (AMC), is located in a rural area, approximately 20km north-east of downtown Salvador. The site is on the metropolitan area of Salvador that includes 10 municipalities and the neighbouring area is residential. Although the total project area is 2,500,000 m^2, the area reserved for waste disposal will be 600,000 m^2. The landfill has a total capacity of 18,000,000 m^3 and receives approximately 850,000 tonnes/year of domestic waste. Current organic content of the waste is approximately 65%.

The geographic system boundaries of AMC includes the current plot of 72 hectares occupied by BATTRE (formerly VEGA) as well as a further 178 hectares to cover the landfill's expansion in subsequent phases outlined in the concession agreement between BATTRE (formerly VEGA) and the Municipal Government of Salvador da Bahia. The concession has validity for 20 years. The concession itself does not discuss biogas. However, the environmental license for the landfill specifies that there should be biogas capture without indicating a specific percentage capture rate. BATTRE's (formerly VEGA) original proposal to the Municipality BID is a contractual document and formed the basis for which it received its license to operate. This document included capture and destruction rates of between 19% and 24% over the life of the landfill.

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

>>

Sectoral scope : 13 : Waste handling and disposal (UNFCCC nomenclature):
Project activity : Landfill gas emission reduction project

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

>>

BATTRE (formerly VEGA), a wholly owned subsidiary of SUEZ Environnement, operates the existing landfill. SUEZ operates 237 landfills throughout the world (206 in Europe) with a total of 32.8 million tonnes of treated waste in 2001. Most of the landfills are equipped with biogas capture and treatment system, particularly those requiring compliance with European waste management regulations. In 2000, 16 of these landfills were equipped with a power generation unit and collectively produced 212,000 MWh using 115,000 m^3 of biogas.

This technology therefore will represent leading-edge technology for landfill management and LFG capture within Brazil and will serve as a replicable model for other such projects.

The technology will be transferred to Brazil through the following actions :

1. Partnership with universities : Federal University of Bahia (UFBA), Cepea/Esalq from São Paulo University (USP), FEA from São Paulo University (USP)
2. Partnership with public agency : CETESB, São Paulo
3. Development of local equipment's suppliers : Flares, Blowers, measurement equipment's, gas capture network equipment and eventually gas to energy plant
4. Involvement of Brazilian Engineering Consultants firms that would then be able to replicate the project

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

>>

Anthropogenic emission of GHG at Salvador Landfill occurs when the methane produced at the landfill is not destroyed.

The proposed CDM project activity pretends to better the landfill gas capture and destruction efficiency by increasing total amount of gas to be destroyed over the amount determined by the landfill concession contract.

Why the emission reductions will not occur in the absence of the proposed project activity ?

Local context at Salvador Landfill

Landfill contract barriers to investment: The call for tender 004/99 launched in 1999 by Salvador Municipality established a maximum price to be paid for the landfill activity: 16,69 R$/ton (5,6 US$/ton). The winning price BATTRE (formerly VEGA) has proposed was 15,86 R $/ ton (5,3 US $/ ton).
That price includes Landfill design, licensing, construction, operation and an aftercare period of 20 years after landfill closure, during while BATTRE (formerly VEGA) will have to maintain installation and treat all leachates to be produced.
Within that very restrictive economical context, and as there was no specific requirement on gas management, BATTRE (formerly VEGA) has calculated a volume - and associated investment and O&M cost - of Landfillgas susceptible to be flared, compatible with its proposed price for the landfill activity.
It is not included in the contract an additional remuneration if BATTRE (formerly VEGA) betters gas capture.
For that reason any investment or operational cost required to destroy more than the contractual amount is additional and will not have other form of remuneration than CERs.
In the baseline study that total cost were estimated to be 45 Millions of BRL for the period 2003 to 2019 shared between investment cost (flares and gas capture works) and operational cost (electricity for pumping, gas network maintenance, handwork, ...)

Landfillgas to energy:

1. There is no Energy Production at Salvador Landfill
2. Energy from Landfill gas could be a technology that represents an economically attractive course of action. However, studies carried by BATTRE has shown that investment would reach 900 US$/kW installed, with operational cost around 12 US$/kWh. Technical risk on gas quality and regular quantity availability is still considered as high. That elements leads to a minimum price of 0,150 R$/kWh to turn energy production economically attractive. Current market price for competitive energy in Brazil is situated between 0,045 R$/kWh to 0,080 R$/kWh, turning energy from Landfillgas not competitive by itself.

   Electricity purchasing price at Salvador Landfill is 0,180 R$/kWh, what could turn electricity production for self-utilisation interesting. However, total projected capacity needs are around 300 kW, what could be produced with less than 5% of contractual volume of gas to be captured in 2004, then not affected proposed baseline.

National and sectoral policies

In Brazil, the generation of municipal solid waste is estimated to be 228,413 tonnes/day (source: IBGE, National Survey on Basic Sanitation, 2000), with a variable regional composition. The amount of wastes generated varies from 0.4 to 0.9 kg/person/day. Final disposal and treatment practices around the country include: 60% of MSW disposed at uncontrolled open localities ("*lixões*") or landfills with some simple form of control, 36% in sanitary landfills, 3% in composting plants, 1% in sorting plants and 0.4% of the MSW is combusted. Typical recovery of methane or biogas is minimal and there is no regulatory requirement governing its recovery. A conservative estimate of 20% recovery of methane gas for passive systems has been considered as the best practice, based on a waste management industry benchmark and BATTRE 's extrapolation of the results of the latest SITA research into this topic. (Source: "*measurement of biogás flow through different final cover at the Montebelluna Landfill – Italy*" – SITA/INERIS – December 2001). A new waste management policy ("*National Politic for Solid Waste*") has been under discussion for many years but currently no changes are anticipated to the existing national policy. There is therefore no national framework governing landfill practice and only technical norms issued by the Brazilian Association of Technical Norms (ABNT) without any technical requirement on LFG management.

The IBGE Study on basic sanitation for State of Bahia shows that in 2000, 60% of MSW was treated in inappropriate site or with simple control, and 39.4 % in sanitary landfills. (Source: www.ibge.gov.br)

With the sanitary landfill as the baseline, the proposed Salvador de Bahia Landfill Gas Management Project creates net real, verifiable GHG emission reductions. The principle mechanism is landfill methane avoided due to improved collection efficiency and destruction capacity. The current contractual obligation of BATTRE for the LFG collection and destruction system, as stipulated in the concession agreement between the Municipality of Salvador de Bahia and BATTRE , only represents an estimated 19-24% of the methane that will be emitted from the entire landfill (source: FAIRTEC study December 2000.) This collection system and destruction capacity will be expanded and improved so that an estimated 75-80% of the methane will be destroyed.

As a result, the Project will result in the production of GHG emissions lower than would occur if the project were not implemented, i.e., in the baseline or business-as-usual scenario. Under an emission reduction purchase agreement (ERPA) to be developed by BATTRE together with a purchasing party, the resulting emission reductions (ERs) would be obtained by *ex-post* review and verification of items identified in the monitoring and verification protocol (MVP). The MVP has been prepared by ICF Consulting (2002) in a companion document called *"Salvador de Bahia Landfill Gas Project: Monitoring and Verification Protocol*." Key items will include the total solid waste entering the landfill, recovered landfill gas flow rate, and percent of methane in the landfill gas. These records would clearly establish the amount of additional methane captured and destroyed over the baseline.

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

>>

Total estimate of anticipated reduction (2004-2019) : **13,958,155** tons of CO2eq

A.4.5. Public funding of the project activity:

>>

None

SECTION B. Application of a baseline methodology

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

>>

AM0002 : "Greenhouse Gas Emission through Landfill Gas Capture and Flaring where the Baseline is established by a Public Concession Contract"

Reference document: VEGA, (1999): technical and commercial proposal to the BID 004/99 for the concession of Salvador de Bahia Landfill Design, Construction and Operation

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

>>

The methodology was developed specifically based on Salvador de Bahia Landfill situation.

As a consequence, the conditions for the methodology to be applicable are respected :

- Landfill concession contract includes all responsibilities for landfill design, construction, operation, maintenance and monitoring ;
- The contract was awarded through a competitive bidding process : Salvador municipality process #004/99 ;
- Concession contractual documents clearly indicate an amount of landfill gas to be captured and flared, referenced to the hypothetical annual quantity of waste to be received, over all contract duration ;
- The contractual amount of LFG to be flared is among the top 20% of the landfills operated in Brazil. As a matter of fact, almost no landfill has installed a gas captured network in the last 5 years in Brazil (see Brazilian Environment Ministry Study to be published);
- There is no energy generation at the landfill using LFG over baseline recovery level.

In relation with that last point, we want to introduce an important comment.

In the methodology proposed by BATTRE , it was indicated as applicability condition the following :

> *"Energy production from landfill gas captured in addition to contractual amount will not happen without CDM project activity"*

As a matter of fact, there is a possibility to produce energy from the LFG. At the moment, generation is not economically feasible due to technical questions related to gas capture and low energy prices. However, as it has a strong sustainable development factor, and since reduction of risk exposure can be achieved with CDM, it is still possible that BATTRE can implement an energy generation project.

If this occurs for such a project, it becomes necessary to have a complete review of the baseline study to determine if the energy generation would modify the hypotheses of the present CDM activity, i.e. if the energy generation would have occurred without the CDM activity.

Others conditions :

Additionally we can stress that the landfill is operated with all required licences and in respects with all the conditions of its operating permit. It should be noted that the landfill has obtained ISO 9000 and ISO 14.000 certification.

In this project, the selection of baseline is relatively straightforward because of the existing contractual document, namely BATTRE 's original technical proposal, between BATTRE and the municipality governing the volume of methane gas to be captured. The legal document covers the contractual lifetime of the landfill and therefore provides an actual, rather than a hypothetical, baseline for the entire creditable period for this project. It therefore presents the business-as-usual scenario that has been agreed to by all parties as a pre-condition for the concession for BATTRE to operate the landfill.

Typical recovery of methane or biogas in Brazil is minimal and there is no regulatory requirement governing its recovery. A conservative estimate of 20% recovery of methane gas for passive systems has been considered as the best practice, based on a waste management industry benchmark and BATTRE 's extrapolation of the results of the latest SUEZ research into this topic. (Source: "*measurement of biogás flow through different final cover at the Montebelluna Landfill – Italy*" – SITA/INERIS – dec2001). A new waste management policy ("*National Politic for Solid Waste*") has been under discussion for many years but currently no changes are anticipated to the existing national policy. There is therefore no national framework governing landfill practice and only technical norms issued by the Brazilian Association of Technical Norms (ABNT) without any technical requirement on LFG management.

B.2. Description of how the methodology is applied in the context of the project activity:

>>

To simplify the presentation of that chapter, we will reproduce, in Italic the original text of the UNFCCC approved baseline methodology AM0002, sections "**Emission reduction**" and "**baseline**".

Symbols and definition are the same than in the AM0002.

Additional information is joined when required by the methodology, or necessary for the good understanding of the project.

Emission Reduction

The greenhouse gas emission reduction achieved by the project activity is the difference between the amount of methane actually destroyed and the amount of methane required to be flared under the terms of the contract. The greenhouse gas emission reduction is expressed in terms of CO_2 *equivalents using the approved Global Warming Potential value for the relevant period.*

Specifically, the greenhouse gas emission reduction (ER_y) *achieved by the project activity during a given year (y) is equal to the methane emission reduction* (ER_CH4_y) *due to the project activity during that year multiplied by a conversion factor (CF) and by the approved Global Warming Potential value for methane (GWP_CH4).*

$$ER_y = ER\_CH4_y * CF * GWP\_CH4$$

ER_y *is the greenhouse gas emission reduction measured in tonnes of* CO_2 *equivalents (tonnes* CO_{2e}*).*
ER_CH4_y *is the methane emission reduction measured in cubic metres (m3(STP) CH4) of methane.*
The conversion factor (CF) is the tonnes of methane per cubic metre of methane at standard temperature and pressure (0.000662 tonnes CH4/m3(STP) CH4). The Global Warming Potential converts 1 tonne of methane to tonnes of CO_2 *equivalents (tonnes* CO_{2e}*/tonne CH4). The approved Global Warming Potential value for methane for the first commitment period is 21 tonnes* CO_{2e}*/tonnes CH4. Thus, GWP_CH4 = 21 until December 31, 2012.*

The methane emission reduction (ER_CH4_y) *due to the project activity is calculated as the difference between amount of methane actually captured and flared less the amount of methane captured and flared in the baseline, which is the amount specified by the contract corrected for the quantity of waste received.*

$$ER\_CH4_y = CH4_{flared,y} - CH4_{baseline,y}$$

$CH4_{flared,y}$ *is determined by monitoring the quantity of methane actually flared using the approved monitoring methodology.* $CH4_{flared,y}$ *is measured in cubic metres (Nm3).*

$CH4_{baseline,y}$ is the quantity of methane required to be flared under the provisions of the contract adjusted for the quantity of waste actually received and the actual methane content of the landfill gas (these adjustments are discussed in the next section).

Baseline

It is assumed that the contract specifies both the quantity of waste projected to be disposed at the landfill during each year ($WASTE_{contract,y}$) and the quantity of landfill gas (LFG) required to be flared during each year. The amount of methane required to be flared each year ($CH4_{contract,y}$) is the quantity of LFG required to be flared as per the contract multiplied by an appropriate methane content to give a conservative baseline.

The quantity of methane projected to be generated during a given year ($CH4_{projected,y}$) is estimated using the following First Order Decay model for landfill gas generation.

$$CH4_{projected,y} = k * L0 * . \Sigma_{t=0,y} WASTE_{contract,t} * e^{-k(t-y)}$$

Where L0 is the methane generation rate (Nm3/tonne WASTE) and k is the decay rate. These variables vary with the circumstances of the landfill; L0 depends upon the organic fraction of the waste that enters the landfill and k depends on the temperature and humidity of the landfill. The validation process should ensure that values of L0 and k appropriate to the landfill are used.

The quantity of landfill gas projected to be generated during a given year ($LFG_{projected,y}$)is calculated from the quantity of methane projected for that year and the methane content of the landfill gas assumed by the contract ($CH4/LFG_{contract}$).

$$LFG_{projected,y} = CH4_{projected,y} / CH4/LFG_{contract}$$

The quantity of methane required to be flared during each year ($CH4_{contract,y}$) as specified in the contract is calculated as follows :

$$CH4_{contract,y} = LFG_{projected,y} * CH4/LFG_{contract} * FD_y$$

Where FD_y is the fraction of landfill gas captured and flared as specified by the contract.

Note that to use this methodology, the project activity must demonstrate that the quantity of methane required to be flared during each year ($CH4_{contract,y}$) reflects performance among the top 20% in the previous five years for landfills operating under similar social, economic, environmental and technological circumstances.

The baseline quantity of methane flared ($CH4_{baseline,y}$) is the quantity specified in the contract ($CH4_{contract,y}$) adjusted for the quantity of waste actually received and the actual methane content of the landfill gas.

$$CH4_{baseline,y} = CH4_{contract,y} * (WASTE_{actual,y}/WASTE_{contract,y}) * ([CH4/LFG_{actual}]/[CH4/LFG_{contract}])$$

Additional information :

The advantage of this approach compared to similar projects in this category is that it avoids any dependence on theoretical biogas generation models where assumptions are required for factors such as initial gas generation potential (*Lo)* and decay rate (*k*).

Contractual amount ($LFG_{contract,y}$) was established based on call for tender technical requirement and economical consideration, i.e. maximum bearable cost that gas capture and destruction can represent within the total cost for Landfill. (see economical considerations in section A.4.4.)

$CH4/LFG_{actual}$ and $CH4/LFG_{contract}$: $CH4/LFG_{contract}$ in Salvador project was considered to be 50%. That value is considered as a best practice world-wide, and is generally achieved only in LFG capture projects associated with energy generation where it is necessary to ensure minimum gas quality. However that performance is generally achieved with prejudice to the global gas recovery efficiency. Indeed, to maintain gas quality, the operator is obliged to work with low negative pressure, or only in areas located far from the covers, to minimise LFG dilution with air.
$CH4/LFG_{actual}$: The approved methodology does not give an accurate definition of that term.
It is not correct to consider native LFG composition (around 60% of CH4) for that value, nor CH4 content obtained in pumping test of short duration and on a landfill in positive pressure situation (pressure inside landfill > atmospheric pressure). As a matter of fact, this value is not representative of the situation of a landfill equipped with an active LFG capture system, working around 25% recovery efficiency.
On an other hand, as CH4 content will be continuously monitored, it could be possible to consider as $CH4/LFG_{actual}$ the value that will be measured. However, as the project intend to maximise LFG capture, high negatives pressures will be applied to the gas wells and additional systems will be developed to captured LFG even in areas in operation and with no final covers. For this reason, the phenomenon of dilution with air could be increased and the CH4 content reduced to value around 35% to 45%. Using that values should not be fair as well, as LFG capture in baseline scenario (LFG recovery around 25%) would not have been such aggressive, resulting in less dilution with air.

As a consequence we suggest to use as $CH4/LFG_{actual}$, for the year Y, the highest of the following value :

- 50%
- weighted average of actual content of CH4 in LFG flared in year Y, as measured through the approved monitoring methodology.

As a consequence, and only for the purpose of the PDD calculation, we will considered that $CH4/LFG_{actual}$ = 50%, what is the most probable. The term ($[CH4/LFG_{actual}]/[CH4/LFG_{contract}]$) will then be consider equal to 1.

Real amount of methane captured and flared will be directly and continuously monitored as indicated in monitoring methodology.

Discussion on the conservatism of the Baseline methodology when applied to Salvador project

Can we consider that the contractual amount represent a performance among the top 20% of its category ?

Previous studies including World Bank studies, as well as a recent study of Brazilian Environment Ministry still to be published, clearly show that gas capture and flaring is not conducted in more than 90% of Brazilian landfills.

The Salvador de Bahia Landfill, as designed by BATTRE in its technical proposal, is probably the only municipal landfill in Brazil that respect European technical standard in relation to bottom lining system, including a complete drainage layer, and in relation with water management.
In the same way, Landfill gas management system indicated in that technical proposal includes an active gas capture network and flaring capacity, defining a contractual volume of gas to be destroyed that represent approximately 25% of projected Landfill gas production. At the present date, no other municipal landfill has such a system installed nor projected, what leads to consider that the Salvador de Bahia Landfill project itself is The Best Practice on that matter.

Sensitivity analyse on the baseline gas capture efficiency rate.

That sensitivity analyse was conducted using First Order Decay model for Landfill gas generation estimation indicated in IPCC guideline, 1996.

Waste entrance stream and baseline contractual amount used in the analyse are indicated in the table below.

Table 1: Projection of Waste Disposal and baseline landfillgas flaring at the Salvador de Bahia Landfill Site

Year	A : $WASTE_{contract}$: *[tones]*	B : $WASTE_{actual}$ *[tones]*	C : $LFG_{contract,y}$ = $LFG_{projected,y}$ * FD_y *[1000 Nm3 @50% CH4]*	D : Annual amount of landfillgas to consider in baseline : D = CxB/A : *[1000 Nm3 @50% CH4]*
1997		28,779		
1998		179,064		
1999		761,392		
2000	790,000	840,000	14,892	15,834
2001	810,000	869,752	14,892	15,990
2002	820,000	838,016	19,360	19,785
2003	840,000		28,784	
2004	860,000		37,230	
2005	870,000		43,187	
2006	890,000		48,399	
2007	910,000		52,122	
2008	930,000		59,568	
2009	950,000		63,291	
2010	960,000		67,014	
2011	980,000		70,737	
2012	1,000,000		74,460	
2013	1,020,000		78,183	
2014	1,040,000		81,906	
2015	1,060,000		83,768	
2016	1,080,000		85,629	
2017	1,150,000		87,863	
2018	1,180,000		89,352	
2019	1,150,000		85,108	

BATTRE estimates the quantity of gas to be produced during the project lifetime using high Lo and K value so that gas production would be overestimated, and, as a consequence, capture efficiency in baseline would be underestimated. The resultant capture efficiency in baseline, around 25%, could have been then compared with the general Brazilian situation to evaluate if that performance was within the top 20 per cent of landfill gas management in Brazil.
However, as the baseline is a fixed contractual amount, and as real Lo and k could be lower than value used for Emission Reduction Estimation, the real gas capture efficiency in baseline will probably be higher than 25%, as it is shown in the sensitivity analyse below.

Methane potential of Salvador Waste :

For Lo, IPCC good practice, 1996 indicates a variation from less than 100 to more than 200 m3 of CH4 per ton of waste. Lo usually adopted for European waste, with approximately 30 % of organic content is 100 m3 CH4/ton.
The Brazilian waste has usually a content of organic matter near 60%. For that reason BATTRE project adopted 180 m3 CH4 / ton of waste (or 0,12 Gg CH4/Gg of MSW).

Moreover, if considering Salvador waste composition determined in January 2001 (*Ramo Saneamento Ambiental*) , corrected to 2003 conditions (suppression of Construction Waste entrance) , we can estimate the following value for Equation 5.4 of IPCC guideline, 1996 :

DOC = (0,4 x A) + (0,17 x B) + (0,15 x C) + (0,3 x D)

In function of information available on site we change that equation to the following one :

DOC = (0,4 x A) + (0,16 x (B + C)) + (0,3 x D)

Where :
A : paper, board and textile : 21 %
B+C : Food and green waste : 60 %
D : wood : 3 %

What result that
DOC = 0,189

Lo calculation :
Lo = MCF x DOC x DOC_f x F X 16/12

Where :
MCF = 1 (well managed landfill)
DOC = 0,189
DOC_f = 0,77 (high biodegradable fraction in Brazilian waste)
F = 60 % (measurement at landfill have shown value of 57 % CH4 in biogas, with small dilution with air)

What result that

Lo = 0,116 Gg of CH4 / Gg of Waste

Biodegradation kinetic :
For k, IPCC good practice, indicates variation from 0,03 (half time of 23 years, dry condition) to 0,2 (half time of 3 years, high temperature an humidity condition).
The Brazilian conditions are quite favorable to biodegradation kinetic, however the project will include a complete cover of the landfill what will have a drying effect on waste disposed.

A halftime of 6 years was then chosen, resulting in k value of 0,12.

LFG production sensitivity to Lo and k, and consequences on project ER estimation

Simulations were made on ER that would occur in case of variation of Lo and k, to lower value.

Results are presented in tables below.

	Total 2003-2019
Total Waste Deposited [tones]:	16.870.000

Baseline study scenario

H1 : Lo=0,12 (180m3 CH4/ton MSW) ; k=0,12 (half time = 6 years)		
Collection Efficiency in baseline : [*calculated*]	**26%**	**Average**
Collection Efficiency in project : [*hypothetical*]	80%	Average
Amount of Methane Emitted from the Landfill [*tones of CH4*]	1.426.460	
Amount of Methane Collected in baseline [*tones of CH4*]	**375.079**	
Amount of methane emitted in baseline [*tones of CH4*]	**1.051.381**	
Amount of Methane Collected in project [*tones of CH4*]	1.141.168	
Amount of Methane emitted in project [*tones of CH4*]	285.292	
Amount of Methane Avoided due to Project [*tones of CH4*]	**689.480**	

Sensitivity analyze

H2 : Lo=0,093 (140m3 CH4/ton MSW) ; k=0,12 (half time = 6 years)		
Collection Efficiency in baseline : [*calculated*]	**34%**	**Average**
Collection Efficiency in project : [*hypothetical*]	80%	Average
Amount of Methane Emitted from the Landfill [*tones of CH4*]	1.112.926	
Amount of Methane Collected in baseline [*tones of CH4*]	**375.079**	
Amount of methane emitted in baseline [*tones of CH4*]	**737.847**	
Amount of Methane Collected in project [*tones of CH4*]	890.340	
Amount of Methane emitted in project [*tones of CH4*]	222.585	
Amount of Methane Avoided due to Project [*tones of CH4*]	**463.735**	

H3 : Lo=0,12 (180m3 CH4/ton MSW) ; k=0,09 (half time = 8 years)		
Collection Efficiency in baseline : [*calculated*]	**30%**	**Average**
Collection Efficiency in project : [*hypothetical*]	80%	Average
Amount of Methane Emitted from the Landfill [*tones of CH4*]	1.244.360	
Amount of Methane Collected in baseline [*tones of CH4*]	**375.079**	
Amount of methane emitted in baseline [*tones of CH4*]	**869.281**	
Amount of Methane Collected in project [*tones of CH4*]	995.488	
Amount of Methane emitted in project [*tones of CH4*]	248.872	
Amount of Methane Avoided due to Project [*tones of CH4*]	**558.368**	

H4 : Lo=0,093 (140m3 CH4/ton MSW) ; k=0,09 (half time = 8 years)		
Collection Efficiency in baseline : [*calculated*]	**39%**	**Average**
Collection Efficiency in project : [*hypothetical*]	80%	Average
Amount of Methane Emitted from the Landfill [*tones of CH4*]	970.851	
Amount of Methane Collected in baseline [*tones of CH4*]	**375.079**	
Amount of methane emitted in baseline [*tones of CH4*]	**595.772**	
Amount of Methane Collected in project [*tones of CH4*]	776.681	
Amount of Methane emitted in project [*tones of CH4*]	194.170	
Amount of Methane Avoided due to Project [*tones of CH4*]	**361.442**	

As we can see in the tables above, gas capture efficiency estimation in baseline is conservative (H1 : 26 %).

As a matter of fact, if real LFG production is lower than estimated in baseline study conditions (H1 : Lo = 0,12 e k=0,12), then collection efficiency in baseline will increase. (up to 39 % in H4 with Lo = 0,093 & k = 0,09).

In that simulation we can also notice that total Amount of methane avoided in project (H1) is estimated 689.480 tones, and that amount dropped to 361.442 tones in H4, if real landfill gas production is lower than estimated in baseline study.

This fact does not affect the conservative approach of the project.

Indeed, as baseline is fixed (contractual obligation, adjusted by real waste entrance), and as real volume of methane destroyed will be directly measured at flare, there is no risk that ER will be certified in excess, what is, in our understanding, the definition of the conservative approach of a CDM project.

As a result, if biogas production is lower than estimated, the volume of ER that will be Certified will be lower than quantity expected in baseline study.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

>>
As indicated in the approved methodology,

"If the actual quantity of methane flared is greater than the baseline quantity flared, the project activity is additional. The emissions reductions will be zero if the project activity is not additional.
Since the baseline quantity flared is determined by the contractual requirement, which is established through a competitive bidding process the baseline reflects what would occur in the absence of the project activity."

Additional considerations : Why the emission reductions will not occur in the absence of the proposed project activity ?

<u>Local context at Salvador Landfill</u>

Landfill contract barriers to investment: The call for tender 004/99 launched in 1999 by Salvador Municipality established a maximum price to be paid for the landfill activity: 16,69 R$/ton (5,6 US$/ton). The winning price BATTRE has proposed was 15,86 R $/ ton (5,3 US $/ ton).
That price includes Landfill design, licensing, construction, operation and an aftercare period of 20 years after landfill closure, during while BATTRE will have to maintain installation and treat all leachates to be produced.

Within that very restrictive economical context, and as there was no specific requirement on gas management, BATTRE has calculated a volume - and associated investment and O&M cost - of Landfillgas susceptible to be flared, compatible with its proposed price for the landfill activity.
It is not included in the contract an additional remuneration if BATTRE betters gas capture.
For that reason any investment or operational cost required to destroy more than the contractual amount is additional and will not have other form of remuneration than CERs.
In baseline study that total cost was estimated to 45 Millions of BRL for the period 2003 to 2019 shared between investment cost (flares and gas capture works) and operational cost (electricity for pumping, gas network maintenance, handwork, ...)

Landfillgas to energy:

3. There is NO Energy Production at Salvador Landfill
4. Energy from Landfillgas could be a technology that represents an economically attractive course of action. However, studies carried by BATTRE has shown that investment would reach 900 US$/kW installed, with operational cost around 12 US$/kWh. Technical risk on gas quality and regular quantity availability is still considered as high. That elements leads to a minimum price of 0,150 R$/kWh to turn energy production economically attractive. Current market price for competitive energy in Brazil is situated between 0,045 R$/kWh to 0,080 R$/kWh, turning energy from Landfillgas not competitive by itself.
   Electricity purchasing price at Salvador Landfill is 0,180 R$/kWh, what could turn electricity production for self-utilisation interesting. However, total projected capacity needs are around 300 kW, what could be produced with less than 5% of contractual volume of gas to be captured in 2004, then not affect the proposed baseline.

The emissions from electricity generation and the avoided emissions from displaced electricity generation have not been used to calculate CERs to ensure a straightforward and conservative baseline. The avoided emissions could be, however, a strong contributor to the overall sustainable development aspects of the project.

With the sanitary landfill as the baseline, the proposed Salvador de Bahia Landfill Gas Management Project creates real, measurable, verifiable, net GHG emission reductions. The principle mechanism is landfill methane avoided due to improved collection efficiency and destruction capacity. The current contractual obligation of BATTRE for the LFG collection and destruction system, as stipulated in the concession agreement between the Municipality of Salvador de Bahia and BATTRE , only represents an estimated 19-24% of the methane that will be generated from the entire landfill (source: FAIRTEC study December 2000.)
With the registered CDM project this collection system and destruction capacity will be expanded and improved so that an estimated 75-80% of the methane will be destroyed.

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

>>

All of the generation of waste occurs locally, within the confines of the country. The Baseline Study has not found leakage to be a problem for the project as the project is a closed system. Therefore the MVP does not correct the calculated ERs to account for leakage.

Two other potential sources of emissions that might offset any reductions achieved were also considered.

Both were assessed as immaterial.

First, potential CO2 emissions generated from CH4 produced by plastics decomposition. For several reasons, this was immaterial. The Revised IPCC Guidelines for National GHG Inventories (1996) do not consider CH4 production from plastic wastes. The level of plastics waste in Salvador is 17% and importantly the contribution to CH4 from plastics is only 5m3 CH4/tonne of MSW compared to the measured emissions of approximately 180m3 CH4/tonne of MSW. Moreover, there is no combustion condition detected in the landfill, firstly because of the naturally high humidity serving as a deterrent and secondly the recent gas analysis undertaken at Salvador shows 0% CO content. CO is considered to be a leading indicator of combustion within the landfill.

The second potential source considered was the potential for emissions resulting from electricity being used to pump methane gas in the new collection equipment (question raised by stakeholder during 30 days international consultation). Given the domination of hydro in the energy resource mix for Bahia, this was also deemed to be immaterial. Moreover, it is planned to produce energy from LFG, for landfill self consumption (200 kW by beginning of 2004).

For that reasons EC_y [1]= 0

[1] ECy : as defined in approved methodology : AM0002

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

>>

Date of completing the final draft of this baseline section: 15 October 2003

Name of person/entity determining the baseline

ICF Consulting

ICF Consulting Project Team

Abyd Karmali
Marcia Gowen Trump
Matt Howes
Myfanwy Price-Jones
akarmali@icfconsulting.com
www.icfconsulting.com

BATTRE

BATTRE Project Officer
Florent Mailly
fmailly@suezambiental.com.br
www.vega.com.br

ICF Consulting would also like to acknowledge the independent review and technical assistance received from:

Marco Monroy and Gautam Dutt of MGM International
José Roberto Moreira and Victor Pulz Filho of NegaWatt

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
01/01/04

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

>>
16 years

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

C.2.1. Renewable crediting period

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

>>
01/01/2004

C.2.1.2. Length of the first crediting period:

>>
7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
not selected

C.2.2.2. Length:

>>
not selected

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>
AM0002 : "Greenhouse Gas Emission Reduction through Landfill Capture and Flaring where the Baseline is established by a Public Concession Contract"

ID number used in following tables refers to ID number in UNFCCC methodology AM0002

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

>>
The methodology was developed based on Salvador Landfill project specific situation.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

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

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

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

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

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

All data will be archived on electronic support through MVP workbook. Each year will be generated a summary sheet that will be signed by Project Manager and archived on paper. All data will be archived during all the project period (2004-2019).

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
2.1	Annual Waste Landfilled	*Measured on site*	[metric tones]	M	Daily	100%	Daily : e Monthly : p	Measured at weigh bridge
2.2	Amount of methane flared	*Measured on site*	[t CH4]	m	Continuou s	100%	Daily : e Monthly : p	Measured by continuous gas quality analyser and flow meter, or complementary method (% CH4, Sm^3/h of LFG, LFG temperature and pressure, flare temperature, flare working hours)
2.3	Total amount of methane flared	*N/a*	[t CH4]	c	Daily	n/a	Daily : e Monthly : p	
2.4	Amount of methane flaring required in baseline	*N/a*	[t CH4]	c	Annually	n/a	Annually : e & p	Contractual amount adjusted by real waste received and actual methane content of the landfill gas
2.5	Amount of methane	*N/a*	[t CH4]	c	Annually	n/a	Annually : e & p	

	collected in addition to requirement							
2.6	Annual Carbon Dioxide Equivalent Avoided	*N/a*	[t CO2e]	c	Annually	n/a	Annually : e & p	

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

The following sets of parameters are all critical to determining the project's emissions, and are used for estimating the emission reductions from the project's improved gas collection efficiency:

- Current amount of waste-in-place: This estimate is based on detailed monthly reported data provided by BATTRE .
- Current methane generation and collection: The current amount of methane generated and collection efficiency is based on estimates from engineering studies provided by BATTRE . Gas measurement is also proceeding on-site to independently verify earlier estimates.
- Waste supply projection: projecting the likely waste production and characteristics in the future for the landfill. This information is used to calculate the likely organic contents of the waste stream and likely emissions of methane. This waste stream projection is based on engineering estimates provided by the landfill operator (BATTRE).
- Landfill expansion and upgrade options: projecting the likely coverage area and collection efficiencies for the landfill. This coverage collection efficiency is based on Brazilian national legislation concerning waste management, operational requirements, and available technologies.

Based on estimates from BATTRE , the landfill of Salvador de Bahia is expected to continue to receive over 850,000 tonnes of waste a year until its close in 2020 as shown in Table 2

Table 2: Projection of Waste Disposal at the Salvador de Bahia Landfill Site

Year	(C) : annual tonnage of waste considered in Concession Contract : $WASTE_{contract}$[2] *[tonnes]*	Actual tonnage of Waste Disposed : $WASTE_{actual}$[2] *[tonnes]*
1997		28,779
1998		179,064
1999		761,392
2000	790,000	840,000
2001	810,000	869,752
2002	820,000	838,016
2003	840,000	
2004	860,000	
2005	870,000	
2006	890,000	
2007	910,000	
2008	930,000	
2009	950,000	
2010	960,000	
2011	980,000	
2012	1,000,000	
2013	1,020,000	
2014	1,040,000	
2015	1,060,000	
2016	1,080,000	
2017	1,150,000	
2018	1,180,000	
2019	1,150,000	

[2] as defined in approved methodology

This waste stream is expected to continue to be of the same basic characteristics over time (same amount of degradable organic content), and therefore expected to have an average methane generation potential of 180 m^3/tonne MSW. The typical trend in many developing countries is to see a gradually reducing proportion of organic materials as other wastes enter the waste stream. Based on this characterisation of the waste stream, the amount of waste disposed, the current quantity of waste in place, and the current methane emissions, the landfill emissions of methane are estimated to follow the curve shown in Figure 1 (below) according to IPCC Good Practices methodology.

The accompanying spreadsheet illustrates how 850,000 tonnes per year (initially), 180 m^3/tonne MSW, and the decay rate (k=0.12) translate into the data shown in Figure 1. This is intended to be indicative since the baseline for this project is set by a contractual obligation and the avoided emissions will be determined by actual measured emissions. This approach therefore avoids any dependence on theoretical biogas generation models.

Emission reductions are calculated based on a number of key assumptions about the generation of methane and its combustion. The emission reductions from the production of methane and its capture are dependent on:

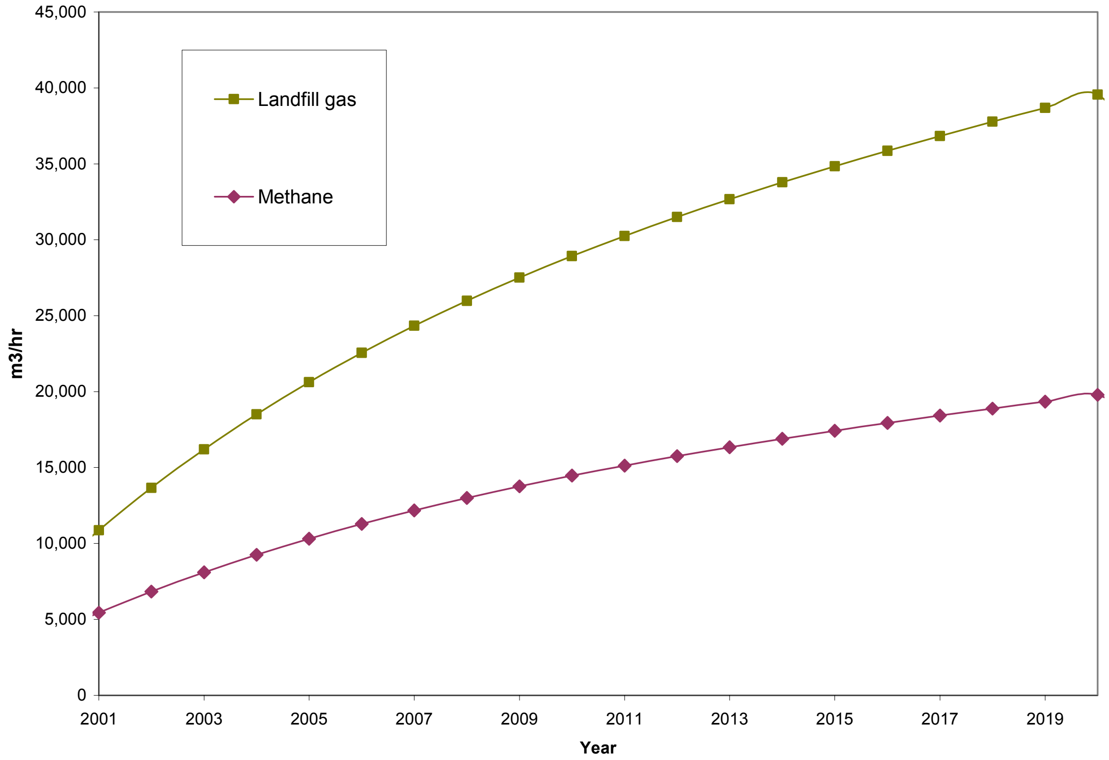
- the amount of waste disposed by year
- the lifetime methane potential of that waste
- the decay of the waste
- the amount of the landfill gas that is methane
- the collection performance in the baseline (the volume indicated in BATTRE proposal to the BID 004/99)
- the collection efficiency in the project

The amount of waste disposed was given in Table 2. The other variables are listed in Table 3.

Table 3: Key Variables in the Production and Collection of Methane

Variable	Units	Value
Lo (methane potential)	m3/tonne MSW	180
k (decay rate)		0.12
% of landfill gas that is methane	%	50%
Collection performance in Baseline	Nm3/year	the exact number varies each year and is indicated in the BATTRE contract : item D12.3. It is estimated to represent a recovery factor of 19-24%
Estimated Collection Efficiency in Project	%	80%

Figure 1: Total landfill gas and methane Production from Salvador da Bahia landfill



D.2.3. Treatment of leakage in the monitoring plan

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

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3.1		Total amount of electricity used for gas pumping	[kWh]	m	n/a	n/a	n/a	Electricity will come from hidro or generated onsite from LFG
3.2		GHG emissions per kWh of electricity used	kg CO2e/ kWh	C or e	n/a	n/a	n/a	Electricity will come from hidro or generated onsite from LFG

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

No leakage applicable

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

The exact same consideration than in D.2.2.2 are applicable

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

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2.1	Low	Already included in Landfill ISSO 9000/14000 certification. Specific procedure for calibration
2.2	Low	Will be included in landfill ISSO 9000/14000 certification scope. Specific procedure to be developed for measurement equipment calibration and maintenance, as well as for calculation module
2.3	Low (calculated)	Will be included in landfill ISSO 9000/14000 certification scope
2.4	Low (calculated)	Will be included in landfill ISSO 9000/14000 certification scope
2.5	Low (calculated)	Will be included in landfill ISSO 9000/14000 certification scope
2.6	Low (calculated)	Will be included in landfill ISSO 9000/14000 certification scope
3.1	n/a	n/a
3.2	n/a	n/a

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

>>

Operational structure : Emission reduction will happen at the flaring station that will be equipped with a specific measurement chain to allow direct measurement of real volume of methane burned, as specified in AM0002.

Management Structure : the project activity will be managed directly by the Landfill gas manager, under the responsability and control of the Executive Director of BATTRE.

Landfill gas management will ahev a dedicated team composed at the begining by :

- the landfill gas manager (1 Engineer)
- the plant operator (1 technician)
- maintenance and control worker (2)

Moreover, the landfill gas management team will receive support for others areas like Quality management team, Purchasing department, Corporate Technical Direction in Brazil and France.

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

>>

ICF Consulting

ICF Consulting Project Team

Abyd Karmali
Marcia Gowen Trump
Matt Howes
Myfanwy Price-Jones
akarmali@icfconsulting.com

BATTRE

BATTRE Project Officer
Florent Mailly
fmailly@suezambiental.com.br

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

As indicate din the Guideline CDMPDD, alternatively it is possible to indicate directly the estimated emission reduction due to the project activity.

In the case of landfill, GHG emission are estimated by calculation using exactly the same model and adopting a different hypothesis of GHG capture efficiency in Baseline and in Project Activity. See D.2.2.2

For such reason it is possible to indicate here directly the estimation of emission reduction, as indicated in E6.

E.2. Estimated leakage:

>>

No leakage applicable

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

>>

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

>>

The baseline for determining avoided landfill emissions due to the project's improvements in collection efficiencies is the volume of gas agreed to in BATTRE 's contract with the municipality. This choice of this baseline is justified by the concept of economic & financial equilibrium of a public contract as defined in National Law 8.666, dated 21/06/93, covering the regulation of public contracts. The Table below indicates (in column two) the volume of landfill methane gas that was specified in the contract between BATTRE and BID governing the concession.

Contractual Requirements Concerning Bahia Concession

Year	(A) : BID 004/99 : financial proposal page n°9 item D12.3 & D12.4 : *Nm3 de LFG @ 50% CH4*	(B) : tonnes equivalent of CH4 : B= $(CH4/LFG_{contract})$[3] * A * 0.000662 (CF[4])
2001	14,892,000	4,914
2002	19,360,000	6,389
2003	28,784,000	9,499
2004	37,230,000	12,286
2005	43,187,000	14,252
2006	48,399,000	15,972
2007	52,122,000	17,200
2008	59,566,000	19,657
2009	63,291,000	20,886
2010	67,014,000	22,115
2011	70,737,000	23,343
2012	74,460,000	24,572
2013	78,183,000	25,800
2014	81,906,000	27,029
2015	83,768,000	27,643
2016	85,629,000	28,258
2017	87,863,000	28,995
2018	89,352,000	29,486
2019	85,108,000	28,086

The estimated anthropogenic emission in the Baseline is the difference between the total GHG production at the landfill and the volume that should be collected and burned as specified in the concession contract.

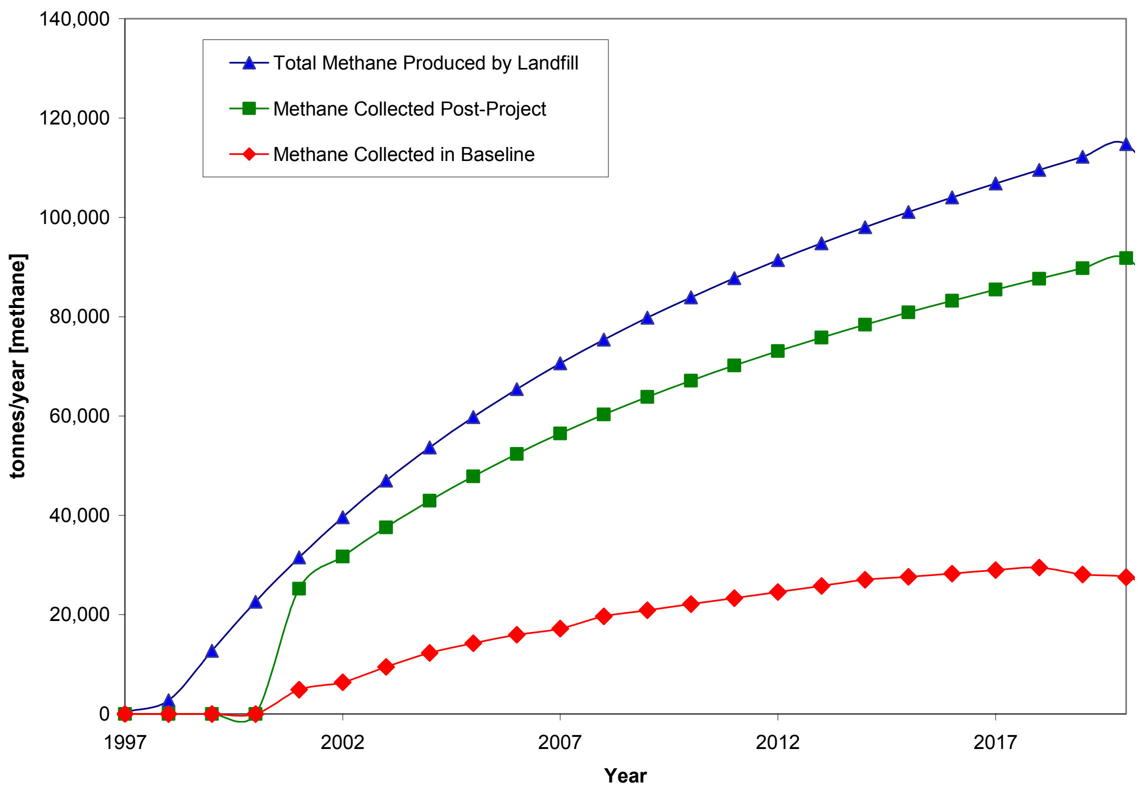
[3] defined in approved methodology AM0002

[4] defined in approved methodology AM0002

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

Figure: Methane Production and Collection, Baseline and Project



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

>>

Summary of Estimated Emission Reductions
for the Salvador de Bahia Landfill Gas Management Project
(tonnes of CO_2 equivalent per year)

Year	ER_CH4[5]
2004	564,310
2005	614,392
2006	663,335
2007	716,442
2008	741,768
2009	786,263
2010	825,139
2011	861,087
2012	894,402
2013	925,419
2014	954,361
2015	993,103
2016	1,030,209
2017	1,073,766
2018	1,121,585
2019	1,192,573
Total	**13,958,155**

SECTION F. Environmental impacts

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

>>

Collection and flaring of landfill gas results in destruction of other gases besides methane. These emissions include volatile organic compounds and sulphur dioxides, among others. These emissions are not considered in this assessment.

If the project subsequently decides to offset electricity from the grid, emissions of ozone and nitrogen oxides that would otherwise be generated from fossil fuels are avoided. These impacts are all of a positive nature but have not been quantified. They contribute to the overall sustainable development attributes of the project.

[5] defined in approved methodology AM0002

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

>>

No significant negative impacts applicable

SECTION G. Stakeholders' comments

>>

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

>>

G.1.1 Official reports announcing a Public Presentation of the project in 3 different local newspapers:

- ***September 27th , 2002**: "Correio da Bahia" page E9; "A Tarde", page N17 and "Diário Oficial do Estado da Bahia" page 4.*
- ***October, 2nd , 2002:** "Correio da Bahia" page E9; "A Tarde", page I15 and "Diário Oficial do Estado da Bahia" page 4.*

G.1.2 Meeting with the press, on October 15th, 2002. Presents:

- *Regina Bochicchio, reporter from "Correio da Bahia" (local newspaper);*
- *Mariana Machado, reporter from "TV Educativa" (Educational channel television);*
- *Humberto Lima, reporter from "Rádio Sociedade" (a local broadcasting station).*

Results:

- *Publication at "Correio da Bahia" on October 16th, Environment section page 8;*
- *Television broadcasting at "TV Educativa" on October 15th ;*
- *Broadcasting at "Rádio Sociedade" on October 15th.*

G.1.3 Public presentation: meeting with the local stakeholders. Completely recorded on video. Presents:

BATTRE	
Artur Tanuri	BATTRE Director
Florent Mailly	Vega Engenharia Ambiental Project Officer
Octavio Nunes	Vega Engenharia Ambiental Marketing and Communication Manager

PRESS	
Vinicius Clay	Correio da Bahia

NOGs	
Fundação ONDAZUL	Leandro Amaral Responsible for ONG

PUBLIC AUTHORITIES	
Jalon Santos Oliveira	SESP Salvador
Rilda Bloise	SESP Salvador
Everaldo Carvalho Silva	SESP Salvador
Ana Maria de Oliveira	LIMPURB
Pedro Roberto Rabelo	LIMPURB
Leda Maria Pinto de Oliveira	SESP Lauro de Freitas
Péricles João dos Santos de Jesus	SESP Simões Filho
Maria de Fátima Espinheira	CONDER
Osvaldo Mendes Filho	CONDER
Sergio Figueiredo	CONDER
Maria de Fatima	CONDER
Josevaldo Costa Ramos	IBAMA/BA
José Guilherme da Mota	IBAMA

PRIVATE SECTOR	
Sean Bradley	Ecosecurities / Globo MVO
Thierry Gisbert	Sita Tech – França
Anesio Fernandes	Clube de Engenharia
José Maria Duarte	Embala Ind. Com. Ltda.
Pedro Ribeiro	Stewart & Stevenson
Marcio Pereira de Souza	Tractebel Energia S/A

UNIVERSITIES	
Marcelo Theoto Rocha	ESALQ/USP
Arthur Penna	UNEB/FAPES
Luiz Mozinio	UFBA
Sarah Ladeira	UFBA
Adalto Azevedo Jr.	UFBA
Miriam Carvalho	UFBA/UCSAL
Sandro Lemos Machado	UFBA
Severino Soares Agra Filho	UFBA
Arilma Oliveira do Carmo	UFBA
Carolina Torres Menezes	UFBA
Atonio Alves Dias	UFBA
Mario Sergio Soares May	UFBA
Ronaldo Bruno Leal	UNIFACS
Wanderley Jr.	UNIFACS

Form for stakeholder comments on the project distributed among the participants during the presentation – see Annex 2.

G.1.4 BATTRE prepared a material available on the internet site (www.vega.com.br) with a briefing of the project and an e-mail address (Vega Bahia.MDL@vega.com.br) for stakeholder comments.

G.1.5 During the public presentation, an accord was signed between BATTRE and CEPEA (Center of economic research of the University of São Paulo). The purpose is to develop a mutual technical and scientific co-operation, exchange of experience, consulting, trainning and suport regarding the subject "Landfills and climate change – how to improve biogas management". Also CEPEA is working on a project for the Environment State Department to estimate the potential of renewable energy generation from landfills in Brazil, with the co-operation of BATTRE .

G.1.6 Technical review by MGM independent consultants, representing CER's potential buyers.

G.1.7 Coming project presentations:

- November 18th , 2002: BATTRE 's project will take part on a case study at a CDM workshop organized by MGM;
- November 30th , 2002: Lecture on a course for journalists promoted by Ipsus (Pro Sustentability Institute).

G.1.8 Additional actions will be planned to gather more stakeholders comments.

G.2. Summary of the comments received:

>>
Only technical comments by MGM.

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

>>
MGM comments will be presented to the validator.
The project was modified to include observations from MGM, the validator.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	BATTRE : Bahia Transferencia e Tratamento de Residuos S.A
Street/P.O.Box:	Estrada Cia-Aeroporto, km 6,5
Building:	
City:	Municipio de Salvador
State/Region:	Estado da Bahia
Postfix/ZIP:	41.505-050
Country:	Brazil
Telephone:	+ 55.71.491.8488
FAX:	
E-Mail:	atanuri@vega.com.br
URL:	www.vega.com.br ; www.suez-env.com ; www.suez.com
Represented by:	
Title:	CEO
Salutation:	Mr.
Last Name:	RADEL
Middle Name:	QUINTAS
First Name:	Lucas
Department:	Bahia Transferencia e Tratamento de Residuos S.A.
Mobile:	
Direct FAX:	+ 55.11.6165.3561
Direct tel:	+ 55.11.6165.3574
Personal E-Mail:	

Organization:	Shell Trading International Limited
Street/P.O.Box:	80 Strand
Building:	80 Strand
City:	London
State/Region:	
Postfix/ZIP:	WC2R 0ZA
Country:	United Kingdom
Telephone:	+44 20 7546 5000
FAX:	+44 20 7546 5134
E-Mail:	Roon.osman@shell.com
URL:	http://www.shell.com
Title:	CDM Manager
Salutation:	Miss
Last Name:	Osman
Middle Name:	
First Name:	Roon
Department:	Environmental Products Trading Business
Mobile:	+44 7984 767 099
Direct FAX:	+44 20 7546 5134
Direct tel:	+44 20 7546 5126
Personal E-Mail:	Roon.osman@shell.com

Organization:	Showa Shell Sekiyu K.K.
Street/P.O.Box:	3-2, Daiba 2 chome, Minato-ku
Building:	Daiba Frontier Building
City:	Tokyo
State/Region:	
Postfix/ZIP:	135-8074
Country:	Japan
Telephone:	+81-3-5531-5627
FAX:	+81-3-5531-5767
E-Mail:	Takashi.Hasegawa@showa-shell.co.jp
URL:	www.showa-shell.co.jp
Represented by:	
Title:	GHG manager
Salutation:	Mr.
Last Name:	Hasegawa
Middle Name:	
First Name:	Takashi
Department:	New Business Development Division
Mobile:	
Direct FAX:	+81-3-5531-5767
Direct tel:	+81-3-5531-5627
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding

Annex 3

BASELINE INFORMATION

See : Salvador da Bahia Landfill Gas Project Baseline Workbook

Annex 4

MONITORING PLAN

See : Monitoring and verification Plan.and :
Salvador da Bahia Landfill Gas Project Monitoring and Verification Workbook and

- - - - -