



REPORT ON GREENHOUSE GAS EMISSION REDUCTION

Project Reference Number: 1636

Project Title: Alto-Tietê landfill gas capture project

Monitoring period: September 25th 2008 – March 04th 2009

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Itaquaquecetuba/SP

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1 INTRODUCTION

A gas collection and flaring system was built in the Itaquaquecetuba landfill operated by Empreiteira Pajoan Ltda.

This project was registered under the Clean Development Mechanism at the UNFCCC, according to the Project Design Document Version 06 of December 13th, 2007, using the approved methodology ACM0001 Version 5.

The Project Design Document was validated by TÜV NORD CERT GmbH in December 13th 2007, approved by the Brazilian Government in February 26th 2008 and registered at the Executive Board in May 29th 2008.

2 OBJECTIVE

This report aims at quantifying the Greenhouse Gas Emission Reductions obtained by the project from September 25th 2008 to March 04th 2009.

The Emission Reductions (ER) are calculated in tones of carbon dioxide equivalent (tCO₂e) and shall be certified by the Designated Operational Entity, according to the Kyoto Protocol and CDM Modalities Procedures.



3 GENERAL DESCRIPTION OF THE PROJECT

The project activity is located in the municipality of Itaquaquecetuba, 40 km from the State Capital, São Paulo, Brazil, in the landfill operated by the private company Empreiteira Pajoan Ltda.. It consists of capturing and flaring the landfill gas which is generated by the decomposition of the waste accepted in the landfill.

The landfill was opened in March 2000 to receive non-hazardous wastes generated in the metropolitan area of São Paulo. The landfill currently receives approximately 2,000 tons/day of wastes.

The project design included an active gas recovery system composed by a collection and transportation pipeline network and a gas flaring system.

The project participants are the project developer, Alto-Tietê Biogás, Redução de Emissões e Geração de Energia Ltda. and Carbon Capital Markets Ltd.



4 TECHNICAL INFORMATION

4.1 Operation history

The first operation tests were performed in September 22nd 2008. The flaring system started to operate continuously in September 25th 2008.

The following table summarizes the availability of the flaring system:

Month	Availability
September 2008 (*)	97%
October 2008	89%
November 2008	97%
December 2008	98%
January 2009	95%
February 2009	98%
March 2009 (**)	92%

(*) Operation started in September 25th 2008

(**) Until March 04th 2009

During the monitoring period covered by this report, the system went out of operation a few times due to the following reasons (decreasing order of significance):

- Electricity supply failure;
- Corrective and preventive maintenance (blowers, flare, general);
- Process alarms;
- Calibration of instruments.



All operations are registered in forms and in electronic spreadsheets. All maintenance procedures in the critical pieces of equipment (flare, blowers, gas analyzer, air compressor) are also registered. Instrumentation calibration records are registered in a workbook and the certificates of calibration are kept in files.

4.2 Monitoring and Data Acquisition

Monitored parameters

As described in section B.7.1 of the PDD and in compliance with ACM0001 Version 05a, the following parameters were monitored:

- Total amount of landfill gas captured from project wells = Total amount of landfill gas flared (m^3);
- Project emissions from flaring of the residual gas stream (tCO_2e);
- Methane fraction in the landfill gas ($\text{m}^3\text{CH}_4/\text{m}^3\text{LFG}$);
- Temperature of the landfill gas ($^\circ\text{C}$);
- Pressure of the landfill gas (mbar);
- Total amount of electricity imported to meet project requirement (MWh/year);
- CO_2e emissions conversion factor for electricity ($\text{tCO}_2\text{e}/\text{MWh}$)
- Landfill Waste (ton);
- Regulatory requirements relating to landfill gas projects
- Combustion efficiency (%);
- Flaring temperature / temperature used for flaring ($^\circ\text{C}$) = Temperature of the exhaust gas ($^\circ\text{C}$);
- Flare working hours (h);
- Volumetric fraction of component i in the residual gas ($i=\text{CH}_4, \text{CO}_2, \text{O}_2$);
- Volumetric flow rate of residual gas (m^3/h);
- Volumetric fraction of oxygen in the exhaust gas;
- Concentration of methane in the exhaust gas (mg/m^3);



Landfill gas flow is automatically measured and registered on a continuous basis and converted automatically to norm cubic meters (Nm^3) by the flow meter, using continuous internal measurements of pressure and temperature.

The following parameters were also automatically measured and registered: CH_4 , CO_2 and O_2 content in the residual gas; CH_4 and O_2 content in the exhaust gas; landfill gas pressure (after compression), landfill gas temperature (after compression), and exhaust gas temperature.

All the above mentioned parameters and the following additional parameters are also manually registered by the operators: gas analyzer readings (landfill and exhaust gas contents), pressure indicator readings, temperature indicator readings. These registers are kept in files.

The amount of electricity imported to meet project requirement is measured monthly by the utility company BANDEIRANTE ENERGIA S.A. An energy meter was installed at ATB in October 15th, 2008, after the operation started (in September 25th, 2008).

An internal audit was performed in January and February 2009, as part of the monitoring plan. A regulatory review was performed, based on the most recent Operation Permit. No changes to the adjustment factor or to the amount of methane that would have been destroyed/combusted during the monitoring period in the absence of the project, in tones of methane (MDreg,y) were identified. Regulatory reviews will be performed at least yearly and will be used to correct the adjustment factor at the renewal of the crediting period, if necessary.

Monitoring Procedures and Documentation

The operation and monitoring procedures are described in the operation manual (“Manual de Partida e Operação” prepared by Arquipélago Engenharia Ambiental Ltda., ref.# P459/R03/V01/08).

Relevant procedures are also described in the maintenance manual (“Manual de Manutenção” prepared by Arquipélago Engenharia Ambiental Ltda., ref.# P459/R04/V01/08) and monitoring manual (“Manual de Monitoramento” prepared by Arquipélago Engenharia Ambiental Ltda., ref# P459/R05/V01/08).



Safety procedures are described in the risk management plan (“Programa de Gerenciamento de Riscos” prepared by Arquiplago Engenharia Ambiental Ltda., ref.# P459/R01/V01/08) and in the emergency plan (“Plano de Ação de Emergência” prepared by Arquiplago Engenharia Ambiental Ltda., ref.# P459/R02/V01/08). A quantitative risk assessment was also performed for the system (“Estudo de Análise de Risco” prepared by Arquiplago Engenharia Ambiental Ltda. ref# P459/R06/V00/08).

The project design and a data book containing detailed technical information are also available.

All operators were trained for operation, maintenance and safety procedures and were granted certificates. The gas analyzer manufacturer SIMENS also trained all operators to handle and calibrate the equipments AG-01 (residual gas analyzer) and AG-02 (exhaust gas analyzer).

The following additional internal procedures and instructions were prepared by ATB. to assure satisfactory monitoring of the project activity, compliant with the PDD:

- Data download and backup
- Instrument maintenance and calibration
- Quality assurance and quality control



5 CER VOLUME CLAIMED

The CER required for the period from September 25th 2008 to March 04th 2009 is **67,296.14 t CO₂e**.

The calculation is as follows, according to ACM0001 Version 5:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH_4} + (EL_{EX, LGFG} - EL_{IMP}) * CEF_{electricity,y} - ET_y * CEF_{thermal,y} \quad (\text{Equation 1})$$

$$MD_{reg,y} = MD_{project,y} * AF$$

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$$

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

$$AF = 20\%^1$$

$$GWP_{CH_4} = 21^2$$

$$D_{CH_4} = 0.0007168 \text{ tCH}_4/\text{m}^3_{CH_4}^2$$

PE_{flare,y} is calculated according to the methodological “Tool to determine project emissions from flaring gases containing methane” – Annex 13 – EB28”.

The control system of the flaring unit automatically records the parameters described in Section 4.2.

ER_y is obtained using the recorded data, Equation 1 (above) and the methodological “Tool to determine project emissions from flaring gases containing methane” – Annex 13 – EB28”.

A detailed description of the calculations is shown in **Annex A**. Monthly ER totalization spreadsheets are shown in **Annex B**.

¹ Source: Approved PDD Version 06 December 13th 2007

² ACM0001 Version 05



The flare efficiency is measured continuously, as described in the methodology ACM0001 Version 05a and the “Tool to determine project emissions from flaring gases containing methane” by measuring methane and oxygen content in the exhaust gas. During the monitoring period, the gas analyzer AG-02 went out of work, as registered in the operation workbook and shown in **Annex C**. In periods when all other monitored parameters were registered and the flaring system operated according to manufacturer’s specifications, a flare efficiency of 90% was assumed, according to STEP 6 of the “Tool to determine project emissions from flaring gases containing methane”.

The sum of ER_y , without discounting electricity and LPG consumption is **67,324.74 tCO₂e**.

Electricity consumption

The instrumentation to measure electricity consumption was installed by the utility company BANDEIRANTE ENERGIA S.A. in October 15th 2008, after the plant start-up in September 25th, 2008. For the period between October 15th 2008 and September 25th, 2008, a conservative calculation was performed, assuming that all the existing devices of the landfill gas capturing and flaring system (total power of 160 kW, as shown in **Annex D**) worked 100% of the time. From this day on, the energy consumption was monitored by the energy bills, until March 04th, 2009.

Period	Energy Consumption (MWh)
September 25 th to October 14 th , 2008 (*)	72.960
October 15 th to November 05 th , 2008	6.731
November 06 th to December 03 rd , 2008	14.653
December 04 th , 2008 to January 05 th , 2009	18.043
January 06 th to February 04 th , 2009	19.991
February 05 th to March 04 th , 2009	21.481
Total	153.859

(*) Conservative calculation



The emission factor is 0.1842 tCO₂e/MWh³.

Hence:

$$EL_{IMP} \times CEF_{electricity} = 0.1842 * 153.859 = \mathbf{28,34 \text{ tCO}_2e}$$

LPG consumption

LPG is used for the flare ignition. Two cylinders of 45kg of LPG are kept in the flaring plant in a specific storage area. The volume of consumed LPG is controlled by the invoices from the suppliers. From the first operation tests performed in September 25th, 2008 to the end of the monitored period March 4th 2008, 2 cylinders of 45kg of LPG were used, totalizing 90 kg.

The discount for LPG consumption is calculated:

$$LPG \text{ emission} = ET_y * CEF_{thermal,y}$$

$$ET_y = Mass_{LPG} * PCI_{LPG}$$

Where:

$$CEF_{thermal,y} = 63.1 \text{ tCO}_2e/TJ^4.$$

$$\text{Lower Heating Value (LHV)}_{LPG} = 10,990 \text{ kcal/kg}^5$$

$$LPG \text{ emission} = 90 \text{ kg} * 10,990 \text{ kcal/kg} * 4186.8 \times 10^{-12} \text{ TJ/kcal} * 63.1 \text{ tCO}_2e/TJ = \mathbf{0.26 \text{ tCO}_2e}$$

³ <http://www.mct.gov.br/index.php/content/view/74691.html> , emission factors 2007

⁴ 2006 IPCC Guidelines for national Greenhouse Gas Inventories, Volume 2, section 2, P16

⁵ [http://www.cetesb.sp.gov.br/Emergencia/produtos/ficha_completa1.asp?consulta=GÁS%20\(ES\)%20DE%20PETRÓLEO,%20LIQÜEFEITO%20\(S\)](http://www.cetesb.sp.gov.br/Emergencia/produtos/ficha_completa1.asp?consulta=GÁS%20(ES)%20DE%20PETRÓLEO,%20LIQÜEFEITO%20(S))



The CER is finally calculated:

$$ER_y = (MD_{\text{project},y} - MD_{\text{reg},y}) \times GWP_{\text{CH}_4} + (EL_{\text{EX,LGFG}} - EL_{\text{IMP}}) \times CEF_{\text{electricity},y} - ET_y \times CEF_{\text{thermal},y}$$

Hence:

$$ER_y = 67,324.74 \text{ tCO}_2\text{e} - 28.34 \text{ tCO}_2\text{e} - 0.26 \text{ tCO}_2\text{e} = 67,296.14 \text{ tCO}_2\text{e}$$

Therefore, the net ERs are **67,296.14 tCO₂e**.

São Paulo, March 16th, 2009.

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ANNEX A

DETAILED DESCRIPTION OF CALCULATIONS



ANNEX B

MONTHLY ER TOTALIZATION SPREADSHEETS



ANNEX C

GAS ANALYZER AG-02 FAILURE PERIODS



ANNEX D

LIST OF INSTALLED EQUIPMENT