

MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 02 – 08/10/2010

Caieiras landfill gas emission reduction
Project 0171

Second Monitoring Period: 01/11/2007 – 30/06/2008

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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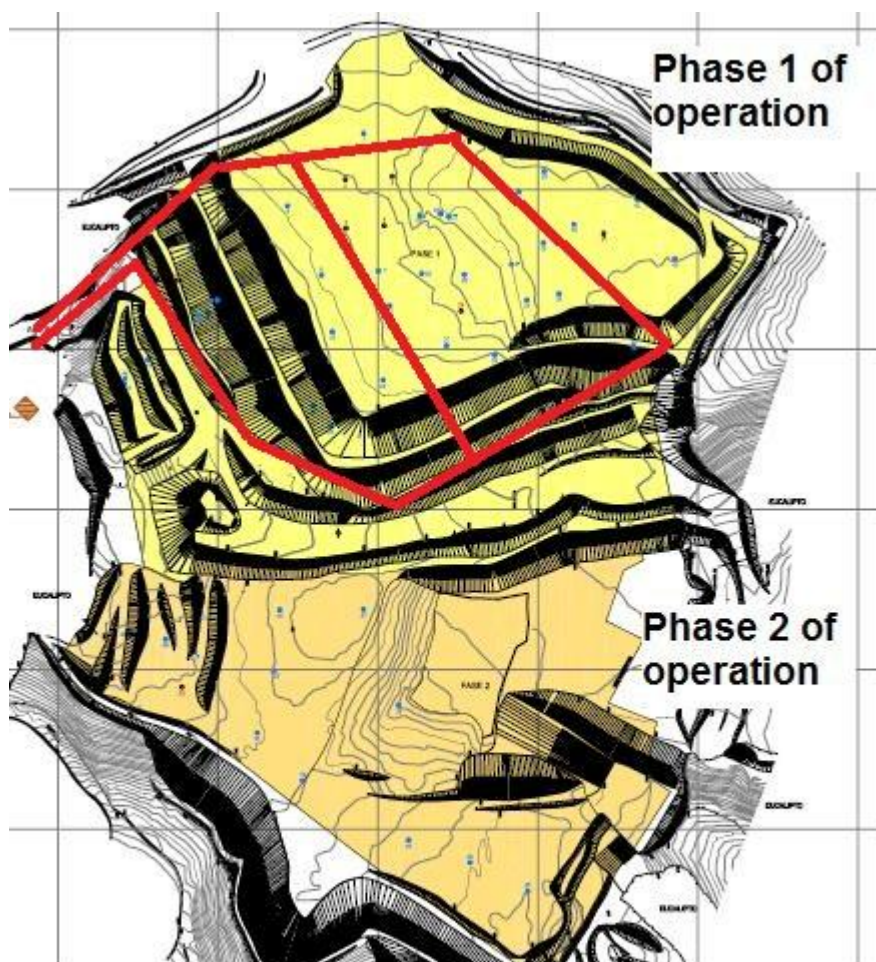
The CDM project activity Caieiras landfill gas emission reduction (UNFCCC registration number 0171) is implemented at the CTR Caieiras landfill and it encompasses (i) capturing of landfill gas (LFG) which is generated as a result of anaerobic decomposition of municipal solid waste (MSW) which is disposed in the site and (ii) the complete destruction of all captured LFG by flaring at high temperature in enclosed flares. LFG is rich in methane, a powerful GHG.

By the end of the monitoring period from 01/11/2007 to 30/06/2008, the implemented LFG collection system consisted of about 90 vertical extraction wells interconnected through a perforated concrete pipes surrounded by gravel. LFG has been extracted from the landfill with the use of 2 blowers and conducted to a main pipe for being sent to the enclosed flare. As required by ACM0001 methodology, the amount and quality of the collected LFG which is sent to the flare has been continuously measured (volume of LFG, CH₄ content of LFG, temperature of LFG, pressure of LFG). All collected LFG has been sent to 1 enclosed flare for combustion at high temperature. The temperature of the exhaust gases of the flare has also been continuously monitored. All the monitoring instruments are installed in the main LFG pipeline. Measuring data are recorded and stored in a computer in the control room.

During the verification period from 01/11/2007 - 30/06/2008 the project activity was implemented in the following configuration:

- 2 blowers with capacity to 4,000 Nm³/h of LFG
- 1 enclosed flare with nameplate flaring capacity of 6,500 Nm³/h of LFG.
- The disposal area of waste used during this period was around 180,000 square meters, with about 2,050,000 tones of waste and approximately 90 wells connected to high density polyethylene (HDPE) LFG collecting pipeline with more than 75% of all wells connected.

Figure 1 shows the location of the LFG collecting wells in the CTR Caieiras landfill.



The red and blue points are the LFG extracting wells

Figure 1 – Map of the LFG collectiong wells in CTR Caieiras landfill

The LFG capture and destruction system was implemented on February 2007. The ESSENCIS's ISO 9001 and ISO 14001 certified QA/EMS systems was earlier implanted on 08/06/2006 and it includes the LFG capture and destruction system in its scope.

A.2. Project Participants

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Project Participants	Name of Parties involved
ESSENCIS SOLUÇÕES AMBIENTAIS S.A. (project developer)	Brazil
ELECTRIC POWER DEVELOPMENT CO., LTD.	Japan

A.3. Location of the project activity:

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The CTR Caieiras landfill is managed and operated by ESSENCIS SOLUÇÕES AMBIENTAIS S.A. and it is located at Bandeirantes highway, Km 33 Caieiras, São Paulo, Brazil. The project site is located in the extreme Northeast region of Caieiras municipality. Caieiras is one of the municipalities encompassing the Metropolitan Region of São Paulo (RMSP).

The project site has the following coordinates:

UTM: N 7418600 to 7416000 and E 317800 to 319800

A.4. Technical description of the project

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The total MSW disposal capacity of the CTR Caieiras landfill is 60,000,000 ton. By the end of the verification period from 01/11/2007 - 30/06/2008, the landfill had received about 6,000,000 ton of MSW with a MSW disposal rate of about 1,000,000 ton of MSW per year. The landfill is currently not expected to close before year 2030.

The implemented LFG collection system consists of a series of vertical wells interconnected through a high density polyethylene pipeline. The wells extract LFG from inside the landfill until the top of the surface. Captured LFG is transported to the LFG destruction station through the high density polyethylene pipeline passing through a condensation pot, where most of the humidity is removed by condensation. Then the collected LFG passes through the 2 blowers. In the blower, the gas temperature increases significantly (typically by 30°C or more). After passing through the blower, the quantity and quality of captured LFG is monitored as required by ACM0001 methodology. It is noteworthy that the LFG temperature in this section is higher than in the condensation pot, and the relative humidity of LFG can be assumed as very low. No relevant condensation is possible in that section. Therefore, it can be assumed that parameters $w_{CH_4,y}$ and $LFG_{flare,y}$ are thus monitored on the same basis as required by ACM0001 methodology.

In the LFG destruction station the following equipment/instruments are installed:

- Condensation trap to separate liquids in the collected LFG (leachate and condensate);
- 1 Blower manufactured by Anton Blaselbauer with nameplate power of 125 HP and nominal capacity for 4,000 Nm³/h of LFG.
- 1 Blower manufactured by Anton Blaselbauer with nameplate power of 100 HP and nominal capacity for 4,000 Nm³/h of LFG
- LFG Monitoring equipment/instruments:
 - 1 LFG flow meter,
 - 1 LFG temperature sensor,
 - 1 LFG pressure sensor,
 - 1 W_{CH_4} Methane fraction in the landfill analyzer,
 - 1 thermocouple (to measure temperature in the exhaust gases of the flare).
- 1 enclosed flare manufactured by BTS Termodinâmica manufacturer with nominal capacity for 6,500 Nm³/h of LFG and normal temperature operation range of 800-1,200 °C.
- 1 Electricity meter manufactured by Kron Medidores (to measure the consumption of electricity by the project activity related equipments)

The following pictures show the project related equipments and instrumentation.



Figure 2 – LFG pipeline and condensation trap

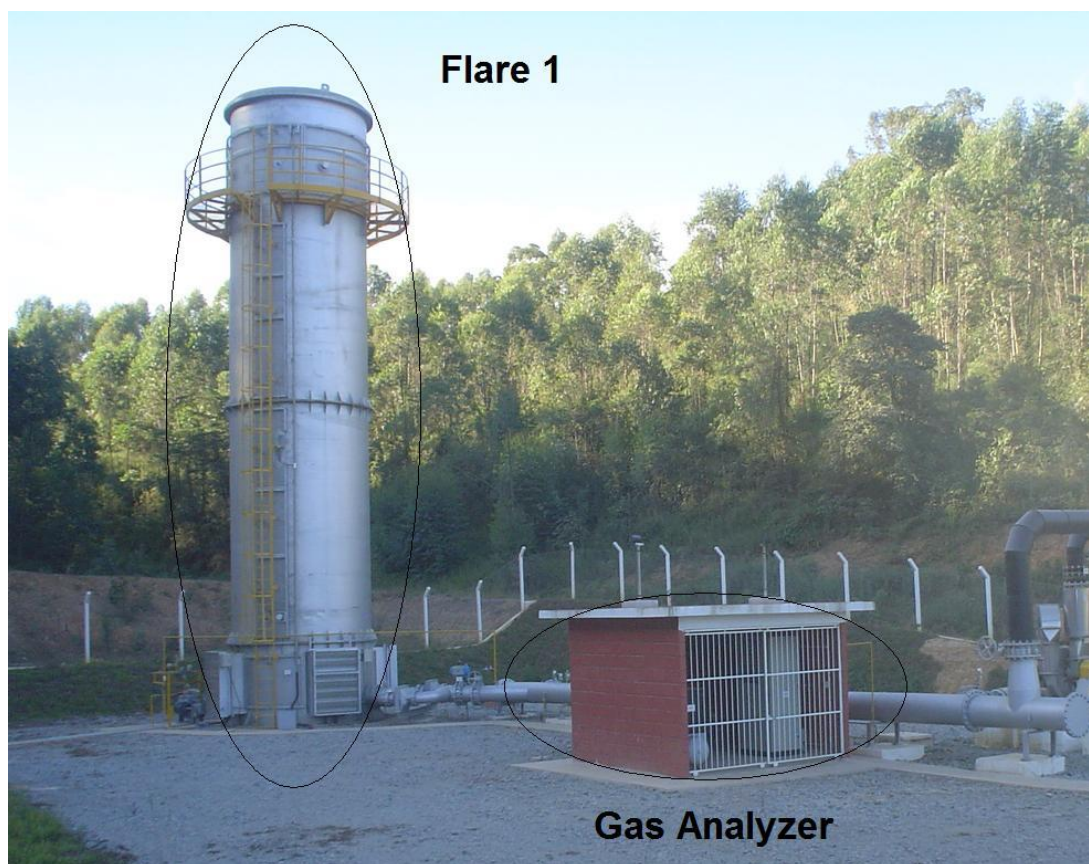


Figure 3– Enclosed flare and CH₄ content gas analyzer



Figure 4 – Flow Meter of LFG



Figure 5 – LFG temperature sensor



Figure 6 – LFG pressure sensor



Figure 7 - thermocouple (to measure temperature in the exhaust gases of the flare)



Figure 8 – Electricity meter

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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The project activity applies the Approved consolidated monitoring methodology ACM0001 - “Consolidated monitoring methodology for landfill gas project activities”, version 02.

The following tools were also used for the determination of leakage emission due to the consumption of grid electricity and LPG by the project activity:

- “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, version 01
- “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”, version 02

A.6. Registration date of the project activity:

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09/03/2006

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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7-year renewable crediting Period from 31/03/2006 to 30/03/2013. No changes to the start date of the crediting period post-registration that have occurred.

A.8. Name of responsible person(s)/entity(ies):

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According the latest version of the completed “Modalities of Communication” document, the person responsible of this Monitoring Report is the focal point of the project: Mr. Fernando Freitas from “Essencis Soluções Ambientais S.A.”

Fernando Freitas – Focal Point

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Phone +55 11 4442-7311

Bandeirantes highway, Km 33 Caieiras, São Paulo, Brazil.

For all technical related manners, Mr. Freitas is also supported by:

Mr. Mark Zulauf – CDM Consultant

Email: markzulauf@gmail.com

Phone +55 71 3239-8714

SECTION B. Implementation of the project activity**B.1. Implementation status of the project activity**

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In general, the project is implemented as per the PDD. The construction of the entire LFG capture and destruction (flaring) system was initiated in 03/2006 and was finished in 12/2006. The tests and commissioning phases occurred in 01/2007 and the official start of measuring and recording of the *ex-post* monitored parameter was initiated on 01/02/2007.

During the monitoring period from 01/11/2007 to 30/06/2008 the following failures or unpredicted events have occurred:

- The electricity meter Kron, model Mult-K (serial number 234215) which is used to measure the amount of electricity consumed by the project had functional problems from 11/2007 to 03/2008 which affected all measurements for this period. As a result of that, the electricity consumption by the project activity for the whole monitoring period was estimated on the basis of the nameplate power output of the two blowers used by the project (considering operation of such blowers under full power 24hrs per day, 30 or 31 days per month).
- During the period from 20/02/2008 to 28/02/2008 there was a problem with recording of measurements of the LFG flow meter. Due to high incidence of rays and rain in the area of the project site, high signal interferences have occurred in the cables that transmits data from the LFG flow meter to the PLC (Programmable Logic Controllers) (which receives the information of the plant and sends to a computer). The problem was resolved in 28/02/2008 by replacing the data cable. All the measurements for this period were thus considered as not monitored.

- During the monitoring period, the project activity was out of operation for a total of 184 hours and 15 minutes due to different reasons.

B.2. Revision of the monitoring plan

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The monitoring plan has not been revised.

B.3. Request for deviation applied to this monitoring period

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There is no deviation applied to this monitoring period.

B.4. Notification or request of approval of changes

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No notification or request of approval of changes from the project activity (as described in the registered PDD) was previously submitted

SECTION C. Description of the monitoring system

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As part of the application of the monitoring plan, data is measured and recorded with the use of a data supervisor system designed by Elipse Software Ltda. (model: e3). Every minute, continuous measurement of LFG flow, LFG pressure, LFG temperature, LFG CH₄ content, LFG CO₂ content, LFG O₂ content, temperature in exhaust gas of the flare are recorded by the system. All recorded data is stored in a SQL format database.

Weekly, 2 data files with monitoring records are generated as part of the application of monitoring procedure: a MS-Excel spreadsheet file and a PDF format file. While data in MS-Excel format is handled as a primary data input for the emission reduction calculations, the PDF format files presents all monitoring records in a table format and are kept as proof that authenticity of data used for emission reduction calculations.

The supervisor system is configured to generate the a MS-Excel spreadsheet files and a PDF files upon request of the user as show in Figure 11.

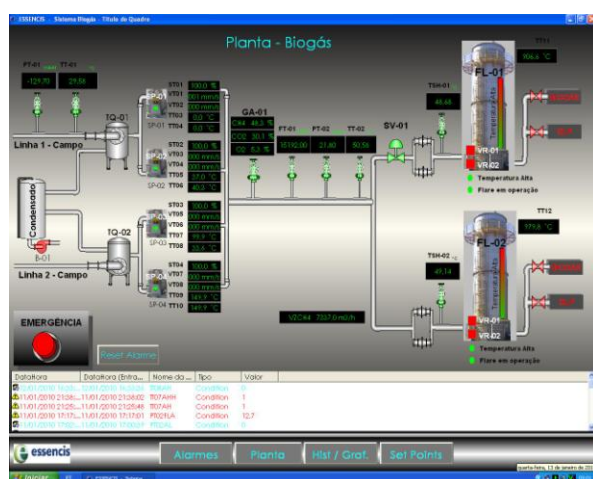


Figure 9 – The main screen of supervisor system



Figure 10 – The screen of supervisor system that the Excel and PDF file is created

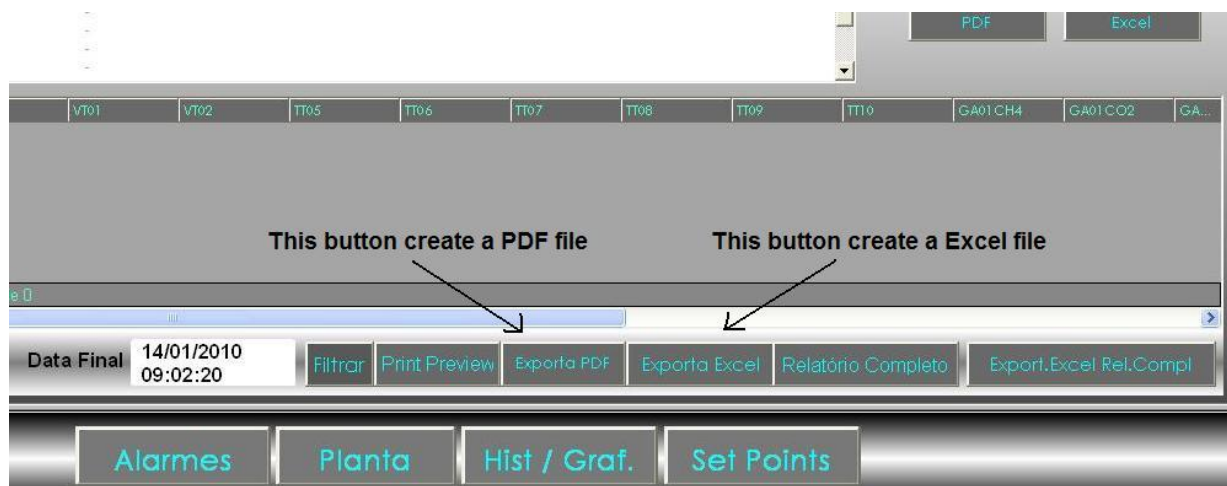


Figure 11 – Zoom of figure 10 showing the buttons to create the MS-Excel and PDF files

Data generated by the supervisor plant system, LFG flow (m^3/h), LFG Methane fraction (%), LFG Pressure (Mbar), LFG Temperature ($^{\circ}\text{C}$), Temperature of the Exhaust gas of the flare ($^{\circ}\text{C}$) is recorded each minute.

They are used in a customized MS-Excel spreadsheet “IMP 403 – Registrador de Dados Isodoc” as input data to calculate the LFG volume (Nm^3), methane volume (Nm^3) and methane mass (kg) accumulated through the data recorded each minute.

Figures from the last data row for each day (data for the period 23:59:00 to 23:59:59) with the accumulated daily values of methane volume (Nm^3) and methane mass (Kg) are transferred to another spreadsheet (Table Summary) where the final emission reduction calculations are performed by considering values for density of CH_4 and AF (*ex-ante* determined) and FE (monitored *ex-post*). As a result of such calculations daily values of emission reductions are reported.

The project is managed by the CDM Project Superintendent at Essencis Soluções Ambientais S.A. The CDM Project Superintendent supervises the CDM Project supervisor who is the one in charge of monitoring related activities (handling of data, preparation the monitoring report).

The operation of the project activity and the application of the monitoring plan is responsibility of the CDM Project Supervisor of the project, who reports all relevant project related issues to the CDM Project Superintendent (operation status of the project activity, results and events, collection and storage of monitoring data, calibration events, and maintenance of equipment).

The CDM Consultant helps the biogas team in operational and monitoring technical issues.

The diagram bellow shows the hierarchy for the project management

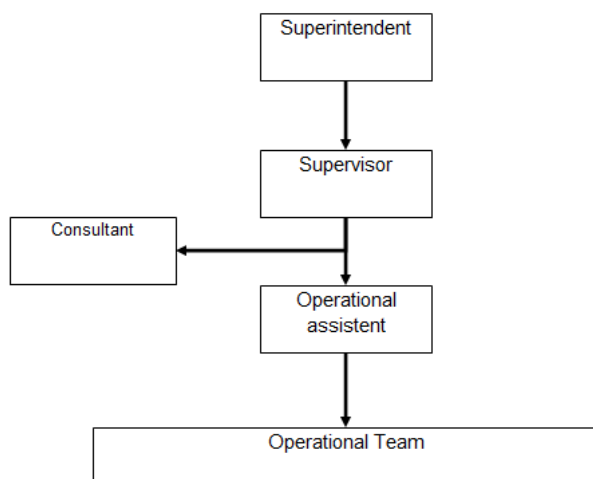


Figure 12 - Hierarchy for the project management

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	D_{CH_4}
Data unit:	tCH ₄ / m ³ CH ₄ STP
Description:	Density of methane.
Source of data used:	ACM0001 version 2
Value(s) :	0.0007168
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Additional comment:	

Data / Parameter:	AF
Data unit:	%
Description:	Adjustment Factor
Source of data used:	Determined considering the amount of methane that it is assumed to be destroyed in the absence of the project.
Value(s) :	20
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	

Data / Parameter:	GWP _{CH₄}
Data unit:	tCO ₂ e/ tCH ₄
Description:	Global Warming Potential
Source of data used:	IPCC Second Assessment Report, 1995
Value(s) :	21

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	

Data / Parameter:	EF _{LPG}
Data unit:	tCO ₂ / ton
Description:	Emission Factor
Source of data used:	Determined as the product between CO ₂ EF _{LPG} and NHV _{LPG} Source for the value of CO ₂ EF _{LPG} : IPCC 2006 volume 2 chapter 2 Source for the value of NHV _{LPG} : Brazilian Energetic Balance
Value(s) :	2.93
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emission calculations
Additional comment:	

Data / Parameter:	NHV _{LPG}
Data unit:	TJ/ton
Description:	Net Heating Value for LPG
Source of data used:	Brazilian Energetic Balance
Value(s) :	0.0465
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emission calculations
Additional comment:	

Data / Parameter:	CO ₂ EF _{LPG}
Data unit:	tCO ₂ /TJ
Description:	The parameter CO ₂ EF _{LPG} is used to determine the parameter EF
Source of data used:	IPCC 2006 volume 2 chapter 2
Value(s) :	63.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions calculations
Additional comment:	

Data / Parameter:	TDL
Data unit:	%
Description:	Transitions and Distributions Losses
Source of data used:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption
Value(s) :	20%
Indicate what the data are	Leakage emissions calculations

used for (Baseline/ Project/ Leakage emission calculations)	
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	LFG _{Flare}
Data unit:	Nm ³
Description:	Amount of LFG flared
Measured /Calculated /Default:	Measured with the LFG flow meter
Source of data:	Monitored in the main LFG pipeline before the flare by a flow meter
Value(s) of monitored parameter:	35,329,832 Nm ³ for this monitoring period. Values of LFG flow presented in minute basis are available in the spreadsheet “IMP 403”
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the LFG flow meter:</p> <ul style="list-style-type: none"> - Manufacturer: Yokogawa Instrument South America - Model: EJA110A - Accuracy: 2% with element - Serial Number: 27EA26928 - Instrument internal identification number: FT01 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Date: 15/03/2007 and 27/03/2008 (Calibration Certificates IOPE RT 011-07 1100 and IOPE RT 011-08 2515) - Entity/company responsible for the calibrations: IOPE Instrumentos de Precisão -
Measuring/ Reading/ Recording frequency:	<p>Measuring frequency: Continuously measured.</p> <p>Recording/reporting frequency: The continuously measured flow of the captured LFG is recorded and reported every minute. Each reported value corresponds to the flow measurement at the last time instant of the minute in question.</p>
Calculation method (if applicable):	
QA/QC procedures applied:	The flow meter is calibrated annually and the data collection procedures are implemented as per company's ISO 9001 and 14001 certified quality and environmental management system.

Data / Parameter:	W _{CH4,v}
Data unit:	%
Description:	Methane fraction in the landfill gas g
Measured /Calculated /Default:	Measured with the gas analyzer
Source of data:	Monitored in the main LFG pipeline before the flare

Value(s) of monitored parameter:	Please, see Section E
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the CH₄ content gas analyzer:</p> <ul style="list-style-type: none"> - Manufacturer: Yokogawa Instrument South America - Model: IR200 - Accuracy: 2% - Serial Number: 6EG5195 - Instrument internal identification number: GA - Calibration frequency (as specified by the monitoring methodology/tool and/or in the PDD): Calibrated every 15 days by a qualified operator - Calibration frequency (as per the application of the monitoring plan): Calibrated every 15 days by a qualified operator - Calibration Dates: - 05/11/2007; 20/11/2007; 13/12/2007, 07/01/2008; 23/01/2008; 08/02/2008; 19/02/2008; 05/03/2008; 20/03/2008; 03/04/2008; 14/04/2008; 24/04/2008; 09/05/2008; 29/05/2008; 11/06/2008; 23/06/2008. - Entity/company responsible for the calibrations: all calibrations were performed by trained responsible staff by following the applicable procedure “PRO 405 Calibração Analisador de Gases” Calibrations are performed with the used of a certified gas cylinders with a known composition. - Pattern Gases used for the calibration events valid for the monitoring period: <ul style="list-style-type: none"> - 60% CH₄: n° 973139 - 60% CH₄: n° 436196 - 60% CO₂: n° 950855 - 60% CO₂: n° 1278502 - 60% CO₂: n° 288617 - 05% O₂: n° 1317839 - 05% O₂: n° 1238633
Measuring/ Reading/ Recording frequency:	<p>Measuring frequency: each 20 seconds</p> <p>Recording/reporting frequency: Every minute reading the value of the last 20 seconds CH₄ content measured.</p>
Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	P
Data unit:	Mbar
Description:	Pressure of the landfill gas
Measured /Calculated /Default:	Measured
Source of data:	Monitored in the main LFG pipeline before the flare
Value(s) of monitored parameter:	Please, see Section E
Indicate what the data are	Baseline emissions calculations

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the LFG Pressure Meter:</p> <ul style="list-style-type: none"> - Manufacturer: Pressgagem Instrumentos de Medição e Controle - Model: TPI Plus - Accuracy: 1.5% - Serial Number: 1201670706 - Instrument internal identification number: PT 02 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Equipment: Pressure Meter - Calibration Date: 08/03/2007 and 19/03/2008 (Calibration Certificate: 4154-07 and 5533-08) - Entity/company responsible for the calibrations: Contemp Laboratório de Metrologia
Measuring/ Reading/ Recording frequency:	Measuring Continuous/Recording frequency Each 1 minute
Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	T
Data unit:	°C
Description:	Temperature of the landfill gas
Measured /Calculated /Default:	Measured
Source of data:	Monitored in the main LFG pipeline before the flare
Value(s) of monitored parameter:	Please, see Section E
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the LFG Temperature Meter</p> <ul style="list-style-type: none"> - Manufacturer: Pressgagem Instrumentos de Medição e Controle - Model: MRT 0403L - Accuracy: 1.0% - Serial Number: 32057 - Instrument internal identification number: TT 02 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Date: 08/03/2007 and 19/03/2008 (Calibration Certificate: 4170-07 and 5509-08) - Entity/company responsible for the calibrations: Contemp Laboratório de Metrologia
Measuring/ Reading/ Recording frequency:	Measuring frequency: Continuously measured. Recording/reporting frequency: each 1 minute

Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	EF _{grid,CM}
Data unit:	tCO ₂ e/MWh
Description:	Emission Factor of the Brazilian Grid
Measured /Calculated /Default:	Calculated
Source of data:	Calculated by the DNA of Brazil
Value(s) of monitored parameter:	2007: 0.1842 2008: 0.3112
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage Emissions due to grid electricity consumption
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calculation results are made publicly available by the Brazilian DNA (http://www.mct.gov.br/index.php/content/view/303072.html)
Measuring/ Reading/ Recording frequency:	Calculated by the DNA of Brazil
Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	T _{flare}
Data unit:	°C
Description:	Temperature of exhaust gas of the flare. This parameter is used to control the efficiency of the combustion flare
Measured /Calculated /Default:	Measured
Source of data:	Monitored after the burn of the LFG, in the end of the flare
Value(s) of monitored parameter:	See Section E
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the thermocouple for measuring the temperature of the exhaust gas of the flare:</p> <p>Two thermocouples were used during the monitoring period from 01/11/2007 to 30/06/2008</p> <p>Period 01/11/2007 to 23/01/2008:</p> <ul style="list-style-type: none"> - Manufacturer: Asta Industria e Comércio de Instrumentação - Model: S - Accuracy: 1.0% - Serial Number: 43545

	<ul style="list-style-type: none"> - Instrument internal identification number: TT 11 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Date: 08/03/2007 (Calibration Certificate: 4168-07) - Entity/company responsible for the calibrations: Contemp Laboratório de Metrologia <p>Period 23/01/2008 to 30/06/2008:</p> <ul style="list-style-type: none"> - Manufacturer: Termoshaw sensores de temperatura - Model: S - Accuracy: 1.0% - Serial Number: 31990 - Instrument internal identification number: TT 11 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Date: 19/03/2008 (Calibration Certificate: 5643-08) - Entity/company responsible for the calibrations: Contemp Laboratório de Metrologia
Measuring/ Reading/ Recording frequency:	Measuring frequency: Continuously measured. Recording/reporting frequency: each 1 minute
Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	Energy
Data unit:	MWh / kg
Description:	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from de gas)
Measured /Calculated /Default:	Measured
Source of data:	Amount of electricity and LPG consumed by the project based on estimation and monitoring of LPG Internal requisitions system records respectively.
Value(s) of monitored parameter:	Grid electricity consumption (EC_{grid}) Nov. 2007: 120.85 MWh Dec. 2007: 124.88 MWh Jan. 2008: 124.88 MWh Feb. 2008: 116.82 MWh Mar. 2008: 124.88 MWh Apr. 2008 81.60 MWh May. 2008 87.57 MWh Jun. 2008 85.00 MWh)

	Leakage _{LPG} = 0.23 (ton)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p>Specifications of the electricity meter:</p> <ul style="list-style-type: none"> - Manufacturer: Kron Medidores - Model: CMC 256 - Accuracy: 1.0% - Serial Number: 234215 - Instrument internal identification number: ME Plant - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): each 5 years - Calibration Date: 02/03/2007 (Calibration Certificate: 518-07) - Entity/company responsible for the calibrations: Kron Medidores <p>No instrument is used to measure consumption of LPG</p>
Measuring/ Reading/ Recording frequency:	<p>Electricity consumption is determined on the basis of measurements of an electricity meter. During significant time of the monitoring period (period from 01/11/2007 to 31/03/2008), the electricity meters faced technical problems. Due to that electricity consumption by the project activity during the monitoring period from 01/11/2007 to 30/06/2008 was estimated. See Section B.1 for further details.</p> <p>The amount of purchased LPG is available at the Essencis Management System. The LPG is only consumed for lighting the flares (flare pilots). Apart of the project activity there is no other demand for LPG in the Caieiras Landfill.</p>
Calculation method (if applicable):	
QA/QC procedures applied:	According the manufacturer, the electricity meter is to be calibrated each 5 years. Data collection and reporting procedures for electricity and LPG consumption are implemented as per company's ISO 9001 and 14001 certified quality and environmental management system.

Data / Parameter:	FE
Data unit:	-
Description:	Methane destruction efficiency (flare efficiency)
Measured /Calculated /Default:	Measured on a sampling basis by a third part company.
Source of data:	ERM do Brasil
Value(s) of monitored parameter:	0.999914
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type,	As per information available in the analysis reports, the measurements

accuracy class, serial number, calibration frequency, date of last calibration, validity)	were performed by using an analyzer FID / Califórnia Analytical Instruments (CAI), model 300 M
Measuring/ Reading/ Recording frequency:	Measurement frequency: 4 time per year (the lowest value is taken)
Calculation method (if applicable):	
QA/QC procedures applied:	

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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To simplify the explanation, the original applicable texts from ACM0001 methodology are reproduced below in *italics*.

Emission Reduction

“The greenhouse gas Emission Reduction achieved by the project activity during a given year “y”(ER_y) is the difference between the amount of methane actually destroyed/combusted during a given year (MD_{project,y}) and the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity (MD_{reg,y}), times the approved Global Warming Potential value for methane (GWP_{CH4}).”

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4}$$

Where:

ER_y is measured in tons of CO₂ equivalents (tCO_{2e});

MD_{project,y} and MD_{reg,y} are measured in tons of methane (tCH₄);

The approved Global Warming Potential value for methane (GWP_{CH4}) for the first commitment period is 21 tCO_{2e}/tCH₄.

Definition of AF and MD_{reg,y}:

“In the case where the MD_{reg,y} is given/defined as a quantity, that quantity will be used”

By following applicable guidance in the PDD, MD_{reg,y} is selected as the higher quantity of methane between the potential methane to be sold to industry (MD_{industry,y}) or 20% of the methane collected by the project activity (Brazilian BAU).

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

As per the PDD:

If MD _{industry,y} < MD _{project,y} x AF (20%)	then MD _{reg,y} = MD _{project,y} x AF (20%)
If MD _{industry,y} > MD _{project,y} x AF (20%)	then MD _{reg,y} = MD _{industry,y}

During the monitoring period from 01/11/2007 to 30/06/2008 no recovered landfill gas was sold to a local industry, thus MD_{reg,y} = MD_{project,y} x 20%

“The methane destroyed by the project activity (MD_{project,y}) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy, if applicable.

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

In Caieiras project case, the two last terms are not considered. The electricity generation from biogas will not be contemplated by the project. The electricity used to pump biogas (potential leakage) is from the grid, hydro power source predominant in the region.

Hence, the final equation results:

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

And then, the $MD_{flared,y}$ is expressed as:

$$MD_{flared,y} = LFG_{flared,y} * w_{CH_4} * FE * D_{CH_4}$$

Where $MD_{flared,y}$ is the quantity of methane destroyed by flaring, $LFG_{flared,y}$ is the quantity of landfill gas flared during the year measured in cubic meters (Nm^3), w_{CH_4} is the methane fraction of the landfill gas as measured during the year and expressed as a fraction ($\%CH_4$), FE is the flare efficiency (the fraction of the methane destroyed), and D_{CH_4} is the methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4)”.

Conversion of values of LFG_{flare} into Normal cubic meters (Nm/h^3)

The installed flow meter measures LFG flow in m^3 /hour by considering fixed reference values for Pressure and Temperature. In order to convert the measured values in Nm/h^3 monitored values of LFG Temperature and LFG Pressure are considered as follows:

$$Q_n = Q_1 * (T_n/T_2 * P_2/P_n) * (T_2/T_1 * P_1/P_2)$$

Where:

Q_n = LFG Flow in Normal cubic meters (Nm^3)

Q_1 = LFG Flow in cubic meters (Nm^3) using the fixed reference values of temperature and pressure

T_2 = Temperature reference fixed value of the instrument (50 oC)

P_2 = Pressure reference fixed value of instrument (1,135 Kg/cm²)

T_1 = LFG Temperature in °C

P_1 = LFG Pressure transmitter in (mBar)

Summary of performed measurements of residual methane in the exhaust gas of the flare (monitoring parameter FE):

Date	Entity / Company in charge of the measurement	Results of the measurements (monitoring parameter FE)
29/10/2007	Environ Resources Management (ERM)	0.99996
21/01//2008	Environ Resources Management (ERM)	0.999925

18/04/20/08	Environ Resources Management (ERM)	0.999914
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Was used the lower values efficiency of burned in the last 3 tests for this period from 01/11/2007 to 30/06/2008 (**99.9914%**)

Emissions due to the consumption of grid electricity are calculated as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) as follows:

$$LE_{EC} = EC_{grid} * EF_{grid,CM} * (1 + TDL)$$

Where:

LE_{EC} emissions due to grid electricity consumption by the project activity

EC_{grid} amount of electricity consumed by the grid in the project activity

$EF_{grid,CM}$ conversion emissions factor for grid electricity

TDL total distribution losses

Emissions factor

The Emission Factor of Brazilian Grid ($EF_{electricity}$) is calculated as the average of the Build Margin (BM) and Operating Margin (OM) of the Brazilian Grid for each year.

$EF_{electricity}$ data for calculation is available at:

$$EF_{electricity,y} = (BM_y + OM_y) / 2$$

Emission Factor _y (tCO ₂ /MWh)			
Build Margin	Operating Margin	Combined Margin	Year
0.0775	0.2909	0.1842	2007
0.1458	0.4770	0.3112	2008

Emission Factor of Brazilian Grid ($EF_{grid,CM,2007}$) = 0.1842 tCO₂e/MWh

Emission Factor of Brazilian Grid ($EF_{grid,CM,2008}$) = 0.3112 tCO₂e/MWh

Amount of electricity consumed by the project activity ($EC_{grid,2007}$): 246 MWh

Amount of electricity consumed by the project activity ($EC_{grid,2008}$): 621 MWh

$$LE_{EC,2007} = EC_{grid,2007} * EF_{grid,CM,2007} * (1+20\%) = 0.1842 \text{ tCO}_2\text{e/MWh} * 246 \text{ MWh} * 1.2 = 54 \text{ tCO}_2\text{e}$$

$$LE_{EC,2008} = EC_{grid,2008} * EF_{grid,CM,2008} * (1+20\%) = 0.3112 \text{ tCO}_2\text{e/MWh} * 621 \text{ MWh} * 1.2 = 232 \text{ tCO}_2\text{e}$$

Leakage emissions resulting from LPG consumption

Emissions due to the consumption of LPG are calculated as per the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion” (version 02) as follows:

$$Leakage_{LPG} = FC_{LPG} * EF_{LPG}$$

Where:

FC_{LPG} = Total consumption of LPG in period (ton)

$EF_{LPG} = CO_2EF_{LPG} * NHV_{LPG}$,

where: $CO_2EF_{LPG} = 63.1 \text{ tCO}_2/\text{TJ}$ and $NHV_{LPG} = 0.0465 \text{ TJ/Ton}$;

$EF_{LPG} = 2.93 \text{ tCO}_2/\text{ton}$

$Leakage_{LPG} = 0.23 \text{ (ton)} * 2.93 \text{ (tCO}_2/\text{ton)} = 0.67 \text{ tCO}_2\text{e}$

Emission _{LPG} (tCO ₂)		
Leakage	FC _{LPG}	EF _{LPG}
0.67	0.23	2.93

E.2. Project emissions calculation

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Not applicable

E.3. Leakage calculation

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Please, see item E.1.

E.4. Emission reductions calculation / table

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$ER = CH_4 \text{ Volume (LFG flow} * W_{CH_4} \text{ Methane fraction)} * \text{Density}_{biogas} * GWP_{CH_4} * AF * FE$

$ER = (16,462,691 * 0.0007168 * 21 * 0.8 * 0.999914)$

ER = 198,230 tCO₂e

TOTAL ER for this period (by considering leakage):		
Leakage due to grid electricity consumption (246 MWh for the period from 01/11/2007 to 31/12/2007 and 621 MWh for the period from 01/01/2008 to 30/06/2008): Total = $(246 * 1.2 * 0.1842) + (621 * 1.2 * 0.3112) = 286$	tCO ₂ e	286
Leakage due to LPG consumption (0.23 t of LPG) Total = $0.23 * 2.93 = 0.67$	tCO ₂ e	1
Total reported emission reductions: = 198,230 – 286 – 1 = 197,943	tCO₂e	197,943

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

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This section shall include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO₂e)	<p>Year 2007 (12 months): 192,974 tCO₂e</p> <p>Year 2008 (12 months): 301,427 tCO₂e.</p> <p>Considering 8 month in 2007: $192,974 * 8 / 12 = 128,649$ tCO₂e. Considering 8 month in 2008: $301,427 * 8 / 12 = 200,951$ tCO₂e.</p>	<p>From 01/11/2007 to 30/06/2008 (8 months): 197,943 tCO₂e</p>

E.6. Remarks on difference from estimated value in the PDD

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The reported emission reductions during the verification period from 01/11/2007 to 30/06/2008 (243 days) are about 54% higher and 1.5% lower than the total emission reductions *ex-ante* estimated in the PDD for the years 2007 and 2008 respectively (in a 8-month equivalence basis).

It is important to note that the *ex-ante* estimations of emission reduction in the PDD for years 2007 and 2008 were made by considering average MSW disposal rate of 4,000 tons of MSW per day (against to 2,000 tons per day that really happens). It is important to note that in year 2007, two other landfill (where MSW generated in the city of São Paulo is also disposed) had operational problems: The Bandeirantes landfill (public Landfill) was closed in March 2007, and part of the MSW stream formally disposed in this landfill (about 4,500 tons of MSW per day) has started to be also disposed in CTR Caieiras landfill, thus increasing the amount of MSW disposed in the project site to about 6,500 tons of MSW (2,000 + 4,500) per day. Moreover, in August 2007, a severe slide accident has occurred in the São João Landfill (another landfill where MSW generated in the city of São Paulo is disposed). As a result of this accident, about 50% of the MSW stream formally disposed in this landfill has also started to be disposed in CTR Caieiras landfill. Thus, instead of receiving 4,000 tons of MSW per day (as estimated in the PDD), more than 10,000 tons of MSW has been disposed in the CTR Caieiras landfill per day from year 2007. This significant increment in the MSW disposal rate has obviously resulted in an increment in the amount of LFG generated in the project site. While the project activity encompasses collecting and destroying LFG at the CTR Caieiras landfill, an increment in the amount of destroyed LFG has thus also occurred, thus increasing the amount of emission reductions in comparison with the *ex-ante* estimation of emission reductions as per the PDD.

It is noteworthy that such significant increment in the amount of MSW disposed in the CTR Caieiras landfill would also occur in the absence of the CDM project activity. Thus, it is correct to consider that emissions of methane in baseline scenario have also increased accordingly.

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory Document Type: Guideline, Form Business Function: Issuance		