

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 01 – 05/10/2010

Caieiras landfill gas emission reduction

Project 0171

Fourth Monitoring Period: 01/01/2010 – 30/09/2010

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 01/01/2010 to 30/09/2010, the implemented LFG collection system consisted of about 110 vertical extraction wells interconnected through a perforated concrete pipes surrounded by gravel. LFG has been extracted from the landfill with the use of 4 blowers and conducted to a main pipe for being sent to 2 enclosed flares. As required by ACM0001 methodology, the amount and quality of the collected LFG which is sent to the flares has been continuously measured (volume of LFG, CH₄ content of LFG, temperature of LFG, pressure of LFG). All collected LFG has been sent to 2 enclosed flares for combustion at high temperature. The temperature of the exhaust gases of the flares 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 01/01/2010 - 30/09/2010 the project activity was implemented in the following configuration:

- 3 blowers with capacity to 4,000 Nm³/h each one and 1 blower with capacity to 7,000 Nm³/h of LFG
- 2 enclosed flares with nameplate flaring capacity of 6,500 Nm³/h of LFG each one.
- The disposal area of waste used during this period was around 330,000 square meters, with about 12,500,000 tons of waste and approximately 110 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 and pipe disposal in the CTR Caieiras landfill. The green points are the connected wells and the red points are the disconnected wells.

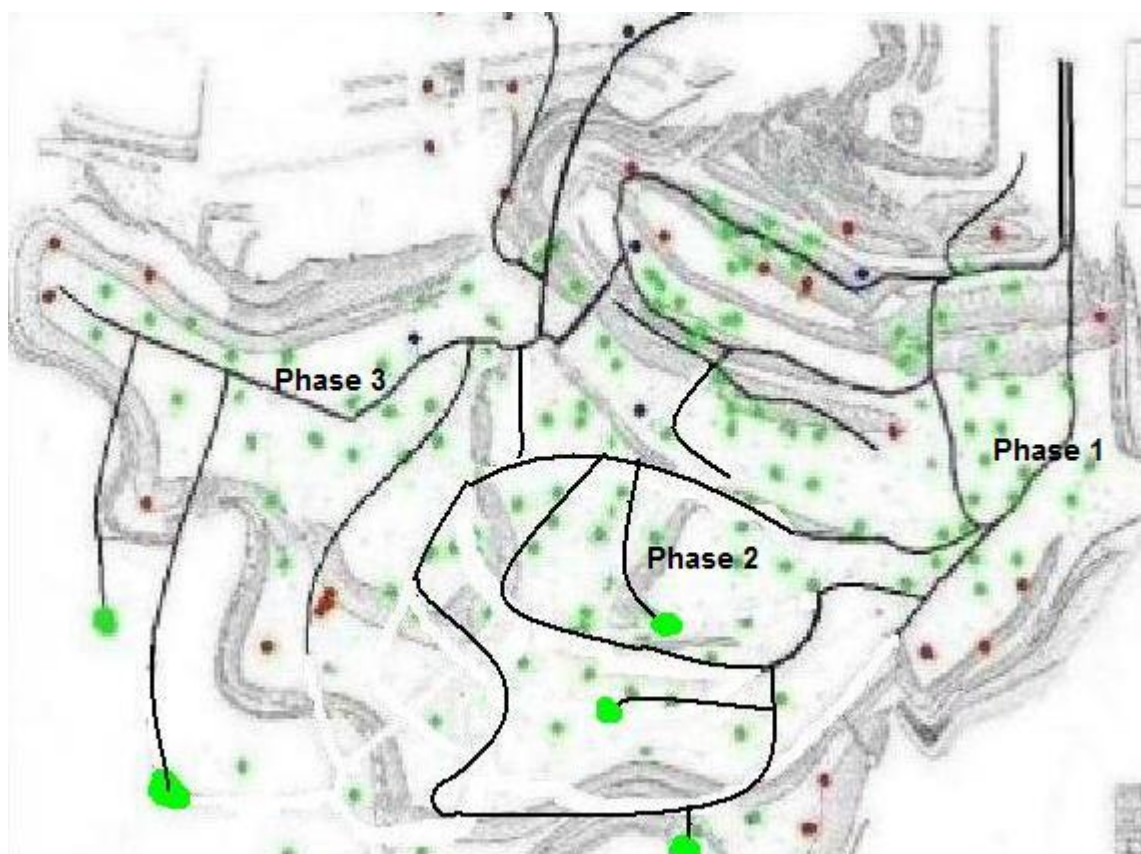


Figure 1 – Map of the LFG collecting wells and pipe disposal in CTR Caieiras landfill

The LFG capture and destruction system was implemented on February 2007. The ESSENCIS's ISO 9001 and ISO 14001 certified QA/EMS systems were 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 01/01/2010 - 30/09/2010, the landfill had received about 12,500,000 ton of MSW with a MSW disposal rate of about 1,400,000 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 4 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:

- 2 Condensation traps 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.
- 2 Blowers manufactured by Anton Blaselbauer with nameplate power of 100 HP and nominal capacity for 4,000 Nm³/h of LFG
- 1 Blower manufactured by Anton Blaselbauer with nameplate power of 200 HP and nominal capacity for 7,000 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,
 - 2 thermocouples (to measure temperature in the exhaust gases of each flare).
- 2 enclosed flares 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.
- 2 Electricity meters (1 to Plant and 1 to Blower 4) 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, Blowers and condensation traps



Figure 3– Enclosed flares, LPG house and CH₄ content gas analyzer



Figure 4– General view of the plant



Figure 5 – Flow Meter of LFG



Figure 6 – LFG temperature sensor



Figure 7 – LFG pressure sensor



Figure 8 – thermocouple (to measure temperature in the exhaust gases of the flare 1)



Figure 9 - thermocouple (to measure temperature in the exhaust gases of the flare 2)



Figure 10 – Electricity meter 1 (Plant)

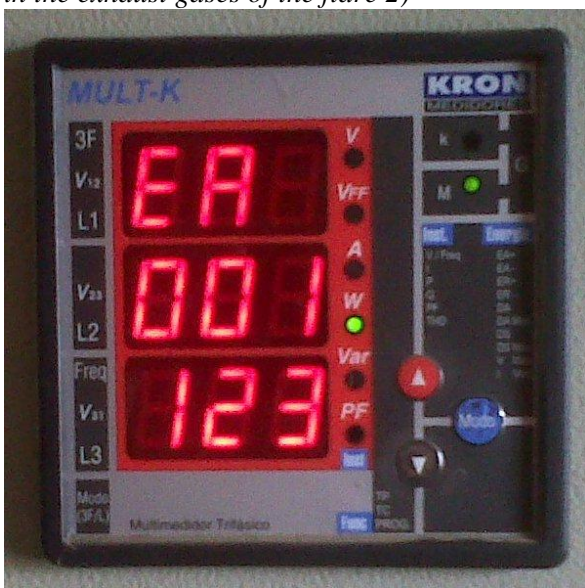


Figure 11 Electricity meter 2 (Blower 4)

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 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

Email: ffreitas@essencis.com.br

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 01/01/2010 to 30/09/2010 the following failures or unpredicted events have occurred:

- From 29/01/2010 (16:27) to 31/01/2010 (23:59) manual backup registers were used due technical problems with the SQL database registers (It was operating in DEMO mode. In this case, it doesn't record data). This is in accordance with applicable internal procedures.;
- During the monitoring period, the project activity was out of operation for a total of 130 hours and 43 minutes due to different reasons resulting in a loss of about 8,800 t CO₂e.

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 flares are recorded by the system. All recorded data is stored in a SQL format database.

Monthly, 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. According the internal procedures, monthly is done a backup of SQL database to guarantee the data of the process.

The supervisor system is configured to generate a MS-Excel spreadsheet files and a PDF files upon request of the user as show in Figure 14.

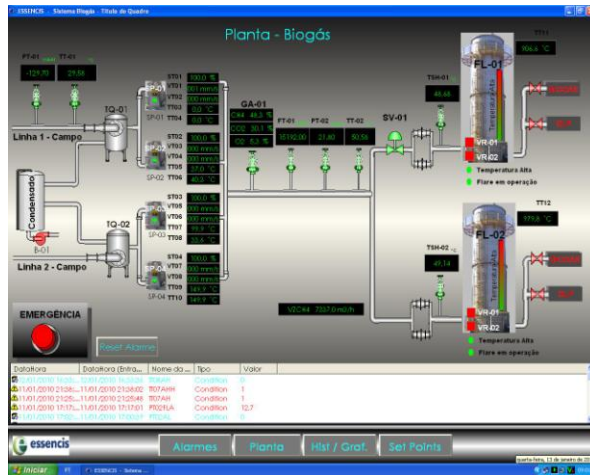


Figure 12 – The main screen of supervisor system



Figure 13 – The screen of supervisor system that the Excel and PDF file is created

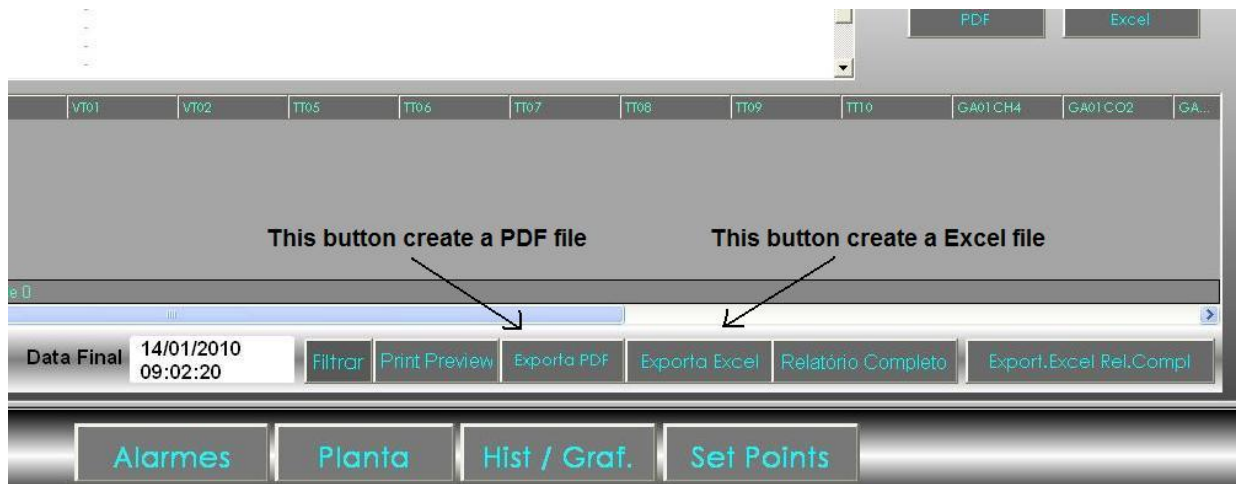


Figure 14 – Zoom of figure 13 showing the buttons to create the MS-Excel and PDF files


Data generated by the supervisor plant system, LFG flow (m³/h), LFG Methane fraction (%), LFG Pressure (Mbar), LFG Temperature (°C), Temperature of the Exhaust gas of the flares (°C) is recorded each minute.

They are used in a customized MS-Excel spreadsheet “IMP 403 – Registrador de Dados Isodoc” (Figure 15, where is created one per month) as input data to calculate:

- 1) **LFG volume (Nm³)** using the LFG flow (m³/h), LFG Pressure (Mbar) and the LFG Temperature (°C);
- 2) **Methane volume (Nm³)** using the LFG Methane fraction (%);

3) Methane mass (ton) using the Density of CH₄;

Those data are recorded and accumulated each minute and is included AF and GWP CH₄ (*ex-ante* determined) and FE (monitored *ex-post*) to calculate the final emissions reductions of each month.

					DADOS DO REGISTRADOR				Unidade: CTR Caieiras
									Data:
									Folha: de

Density CH ₄	0.0007168
Flare Efficiency (FE)	0.999971
GWP CH ₄	21
AF = 20%	0.2

Register	(LFG total = LFG Flare) LFG Flow (1 min)	Accumulated LFG (Month)	LFG flow * W CH ₄ (1 min)	Accumulated (LFG flow * W CH ₄) (Month)	(MD Flare = MD Project) (MD Proj = LFG Flow * W CH ₄ * Density CH ₄) (1 min)	Accumulated MD Proj (Month)	(AF = 20%) (MD reg = MD Proj * AF) (Month)	ER = (MD Proj - MD reg) * GWP CH ₄ * FE (Month)
<i>each 01 minute</i>	<i>Nm3 LFG</i>	<i>Nm3 LFG</i>	<i>Nm3 CH₄</i>	<i>Nm3 CH₄</i>	<i>ton CH₄</i>	<i>ton CH₄</i>	<i>ton CH₄</i>	<i>ton CO₂e</i>
31/7/2010 23:40:30	220.60	8,985,709.48	97.05	4,465,400.71	0.0696	3,200.7992	640.16	53,771.87
31/7/2010 23:41:30	221.65	8,985,931.13	97.49	4,465,498.20	0.0699	3,200.8691	640.17	53,773.04
31/7/2010 23:42:30	221.39	8,986,152.52	97.44	4,465,595.64	0.0698	3,200.9390	640.19	53,774.21
31/7/2010 23:43:30	221.56	8,986,374.08	97.45	4,465,693.09	0.0699	3,201.0088	640.20	53,775.39
31/7/2010 23:44:30	221.63	8,986,595.71	97.46	4,465,790.55	0.0699	3,201.0787	640.22	53,776.56
31/7/2010 23:45:30	221.46	8,986,817.16	97.40	4,465,887.95	0.0698	3,201.1485	640.23	53,777.73
31/7/2010 23:46:30	220.83	8,987,037.99	97.13	4,465,985.08	0.0696	3,201.2181	640.24	53,778.90
31/7/2010 23:47:30	220.16	8,987,258.15	96.83	4,466,081.91	0.0694	3,201.2875	640.26	53,780.07
31/7/2010 23:48:30	219.96	8,987,478.11	96.72	4,466,178.63	0.0693	3,201.3568	640.27	53,781.24
31/7/2010 23:49:30	219.42	8,987,697.53	96.51	4,466,275.14	0.0692	3,201.4260	640.29	53,782.40
31/7/2010 23:50:30	221.87	8,987,919.40	97.56	4,466,372.71	0.0699	3,201.4960	640.30	53,783.57
31/7/2010 23:51:30	221.78	8,988,141.18	97.76	4,466,470.47	0.0701	3,201.5660	640.31	53,784.75
31/7/2010 23:52:30	222.64	8,988,363.82	98.14	4,466,568.61	0.0703	3,201.6364	640.33	53,785.93
31/7/2010 23:53:30	219.88	8,988,583.70	96.92	4,466,665.54	0.0695	3,201.7059	640.34	53,787.10
31/7/2010 23:54:30	221.62	8,988,805.32	97.72	4,466,763.25	0.0700	3,201.7759	640.36	53,788.28
31/7/2010 23:55:30	222.22	8,989,027.54	98.17	4,466,861.43	0.0704	3,201.8463	640.37	53,789.46
31/7/2010 23:56:30	221.55	8,989,249.09	97.90	4,466,959.33	0.0702	3,201.9164	640.38	53,790.64
31/7/2010 23:57:30	220.98	8,989,470.06	97.63	4,467,056.95	0.0700	3,201.9864	640.40	53,791.81
31/7/2010 23:58:30	222.35	8,989,692.41	98.21	4,467,155.16	0.0704	3,202.0568	640.41	53,792.99
31/7/2010 23:59:30	221.17	8,989,913.58	97.73	4,467,252.89	0.0701	3,202.1269	640.43	53,794.17

Figure 15- "IMP 403 – Registrador de Dados Isodoc" is a final part of customized MS-Excel spreadsheet that are used to calculate the monthly emissions reductions of CO₂e.

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

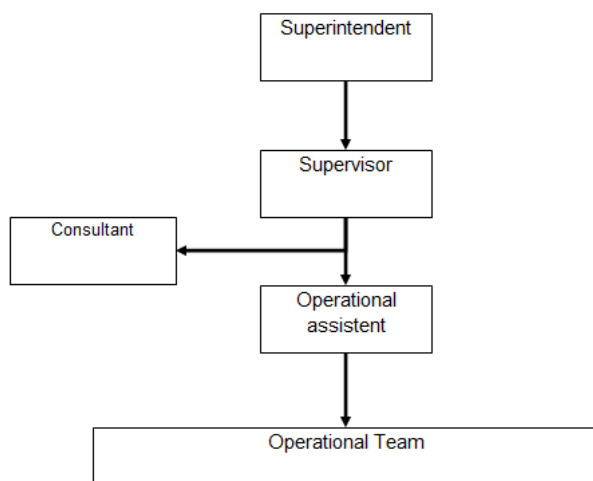


Figure 16 - Hierarchy for the project management

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:	80,576,066 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: 16/04/2010 (Calibration Certificates IOPE RT 011-10/2121) - 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: - 08/01/10; 15/01/10; 22/01/10; 29/01/10; 05/02/10; 12/02/10; 19/02/10; 26/02/10; 05/03/10; 13/03/10; 19/03/10; 26/03/10; 03/04/10; 09/04/10; 16/04/10; 23/04/10; 30/04/10; 07/05/10; 14/05/10; 21/05/10; 28/05/10; 11/06/10; 18/06/10; 28/06/10; 02/07/10; 16/07/10; 23/07/10; 02/08/10; 06/08/10; 13/08/10; 20/08/10; 27/08/10; 03/09/10; 10/09/10; 17/09/10; 24/09/10. - 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° 112252 - 60% CO₂: n° OG2167 - 60% CO₂: n° 16558 - 05% O₂: n° 14319
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: Pressgag 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: 03/03/10 (Calibration Certificate: 2914-10) - 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: Pressgag 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: 03/03/10 (Calibration Certificate: 2916-10) - 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:	
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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:	2009: 0.1635 Brazilian Government did not issued the 2010 EF, so the factor of 2009 was considered for the period from January/10 to September/10
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 flares. This parameter is used to control the efficiency of the combustion flares
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)	Specifications of the thermocouple for measuring the temperature of the exhaust gas of the flares: Thermocouples of exhaust gas of the flare 01 (TT 11) <ul style="list-style-type: none"> - Manufacturer: Asta Industria e Comércio de Instrumentação - Model: S - Accuracy: 1.0% - Serial Number: XVII - Instrument internal identification number: TT 11 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially

	<p>accredited entity</p> <ul style="list-style-type: none"> - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Date: 05/03/10 (Calibration Certificate: 2956-10) - Entity/company responsible for the calibrations: Contemp Laboratório de Metrologia <p>Two thermocouples of exhaust gas of the flare 02 (TT 12) was used for the period of this audit (from 01/01/10 to 30/09/10)</p> <p>From 01/01/10 to 05/03/10:</p> <ul style="list-style-type: none"> - Manufacturer: Naka Instrumentação Industrial - Model: K - Accuracy: 1.0% - Serial Number: E05661001A - Instrument internal identification number: TT 12 - 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: 05/05/2009 (Calibration Certificate: 11149-09) - Entity/company responsible for the calibrations: Calibratec Comercio e Calibração de Instrumentos <p>From 05/03/10 to 30/09/10:</p> <ul style="list-style-type: none"> - Manufacturer: Naka Instrumentação Industrial - Model: K - Accuracy: 1.0% - Serial Number: 13853 - Instrument internal identification number: TT 12 - 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: 05/03/10 (Calibration Certificate: 2957-10) - 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 (electricity) / kg (LPG)
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	Measured

/Default:	
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:	<p>Grid electricity consumption (EC_{grid})</p> <p>Year: 2010</p> <p>Jan/2010: 192.43 Feb. /2010: 179.43 Mar. /2010: 197.26 Apr. /2010: 195.18 May. /2010: 203.93 Jun. /2010: 177.61 Jul. /2010: 162.19 Aug. /2010: 215.72 Sep. /2010: 189.00</p> <p>Consumption of LPG = 0.59 ton</p>
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> <p>Electricity meter 01</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>Electricity meter 02 (Blower 4)</p> <ul style="list-style-type: none"> - Manufacturer: Kron Medidores - Model: CMC 256 - Accuracy: 1.0% - Serial Number: 465025 - Instrument internal identification number: ME Blower 4 - 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

	<p>plan): each 5 years</p> <ul style="list-style-type: none"> - Calibration Date: 03/10/2008 (Calibration Certificate: 2600-08) - Entity/company responsible for the calibrations: Kron Medidores <p>No instrument is used to measure consumption of LFG</p>
Measuring/ Reading/ Recording frequency:	<p>Electricity consumption is determined on the basis of measurements of an electricity meter.</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:	<p>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.</p>

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:	ECOSAMPLING Avaliações Ambientais
Value(s) of monitored parameter:	0.999971
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)	As per information available in the analysis reports, the measurements 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 between flare 1 and 2 for the period (4 tests of each flare).
Calculation method (if applicable):	
QA/QC procedures applied:	

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>>

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}).”

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH_4}$$

Where:

ER_y is measured in tons of CO₂ equivalents (tCO₂e);

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 tCO₂e/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).

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

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 01/01/2010 to 30/09/2010 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:

$$MD_{flared,y} = LFG_{flared,y} * w_{CH_4y} * FE * D_{CH_4}$$

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 (Nm³), w_{CH₄y} is the methane fraction of the landfill gas as measured during the year and expressed as a fraction (%CH₄), 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 flow meter measure in m^3 , to transform in Nm^3 is used the follow formula considering the STP standard temperature and pressure: 1 Atm (1 Bar) and 0 °C (273 K):

$$Q_n = Q * (273/(273 + TT)) * (1 + (PT/1000))/1$$

Where:

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

Q = Flow in cubic meters (m^3)

TT = Temperature transmitter in °C

PT = 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)
21/10/2009	Ecosampling Avaliações Ambientais	0.999974
11/01/2010	Ecosampling Avaliações Ambientais	0.999978
20/04/2010	Ecosampling Avaliações Ambientais	0.999971
07/07/2010	Ecosampling Avaliações Ambientais	0.999974

The lowest value is taken between flare 1 and 2 for the period.

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

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

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

Emission Factor _y (tCO ₂ /MWh)			
Build Margin	Operating Margin	Combined Margin	Year
0.0794	0.2476	0.1635	2009

Brazilian Government did not issued the 2010 EF, so the factor of 2009 was considered for the period from January/10 to September/10

Emission Factor of Brazilian Grid ($EF_{\text{grid,CM},2009}$) = 0.1635 tCO₂e/MWh

Amount of electricity consumed by the project activity ($EC_{\text{grid},2010}$): 1,712.75 MWh

$$LE_{\text{EC},2010} = EC_{\text{grid},2010} * EF_{\text{grid,CM},2009} * (1+20\%) = 1,712.75 \text{ MWh} * 0.1635 \text{ tCO}_2\text{e/MWh} * 1.2 = 336 \text{ tCO}_2\text{e}$$

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:

$$\text{Leakage}_{\text{LPG}} = FC_{\text{LPG}} * EF_{\text{LPG}}$$

Where:

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

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

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

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

$$\text{Leakage}_{\text{LPG}} = 0.59 \text{ (ton)} * 2.93 \text{ (tCO}_2/\text{ton)} = 1.73 \text{ tCO}_2\text{e}$$

Emission _{LPG} (tCO ₂)		
Leakage	FC_{LPG}	EF_{LPG}
1.73	0.59	2.93

E.2. Project emissions calculation

>>

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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$$ER = (MD \text{ Proj} - MD \text{ reg}) * GWP \text{ CH}_4 * FE$$

CO2e CALCULATIONS						
FROM	TO	Accumulated LFG (Month)	Accumulated (LFG flow * W CH4) (Month)	Accumulated MD Proj (Month)	(AF = 20%)	ER = (MD Proj - MD reg) * GWP CH4 * FE
		Nm3	Nm3	ton CH4	ton CH4	Ton CO2e
1/1/2010 00:00:53	31/1/10 23:59	9,357,381.05	4,487,269.49	3,216.47	643.29	54,035.21
1/2/2010 00:19:19	28/2/2010 23:59:20	8,290,212.84	3,804,466.10	2,727.04	545.41	45,812.97
1/3/2010 00:00:20	31/3/2010 23:59:21	8,674,612.52	3,800,008.84	2,723.85	544.77	45,759.29
1/4/2010 00:00:21	30/4/2010 23:59:28	8,725,038.20	4,160,929.85	2,982.55	596.51	50,105.46
1/5/2010 00:00:28	31/5/2010 23:59:03	9,187,422.92	4,280,223.39	3,068.06	613.61	51,541.98
1/6/2010 00:00:03	30/6/2010 23:59:08	9,186,402.91	4,062,574.79	2,912.05	582.41	48,921.08
1/7/2010 00:00:08	31/7/2010 23:59:30	8,989,913.58	4,467,252.89	3,202.13	640.43	53,794.17
1/8/2010 00:00:30	31/8/2010 23:59:42	9,716,030.70	4,651,871.38	3,334.46	666.89	56,017.33
1/9/2010 00:00:42	30/9/2010 23:59:30	8,449,051.66	4,161,289.98	2,982.81	596.56	50,109.80
Total CO2e for the period						456,097.29

TOTAL ER for this period (by considering leakage):

Leakage due to grid electricity consumption was 1,712.75 MWh for the period from 01/01/2010 to 30/09/2010:

$$\text{Total} = (1,712.75 * 0.1635 * 1.2) = 336$$

Leakage due to LPG consumption (0.59 t of LPG)

$$\text{Total} = 0.59 \times 2.93 = 1.73$$

Total reported emission reductions: = 456,097 – 336 – 2 = 455,759tCO₂e

336

tCO₂e

2

tCO₂e**455,759****E.5. Comparison of actual emission reductions with estimates in the CDM-PDD**

>>

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO₂e)	Year 2010 (12 months): 396,761 tCO ₂ e. Considering 9 months in 2010: $396,761 / 12 * 9 = 297,571 \text{ tCO}_2\text{e}.$	From 01/01/2010 to 30/09/2010 (09 months): 455,759 tCO₂e

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

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The reported emission reductions during the verification period from 01/01/2010 to 30/09/2010 (270 days) are about 53% higher than the total emission reductions *ex-ante* estimated in the PDD for the year 2010 (in equivalence basis).

It is important to note that the *ex-ante* estimations of emission reduction in the PDD for year 2010 was made by considering average MSW disposal rate of 4,000 tons of MSW per day.

The reality was different that the estimative.

Until March/2007, CTR Caieiras landfill was receiving 2,000 tons per day.

The Bandeirantes landfill (public Landfill) was closed in March 2007, and part of the MSW stream formally disposed in this landfill (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.

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 4,000 tones of the MSW stream formally disposed in this landfill has also started to be disposed in CTR Caieiras landfill, resulting in more than 10,000 tons of MSW has been disposed in the CTR Caierias landfill per day. This quantity of waste has kept during this monitoring period.

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.

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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		