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

CONTENTS

MONITORING REPORT
Version 01- 09/02/2011

BANDEIRANTES LANDFILL GAS TO ENERGY PROJECT (BLFGE)
0164
17th Monitoring Period – From 01/11/2010 to 22/12/2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

Bandeirantes Landfill Gas to Energy Project (BLFGE) is a project designed to explore the landfill gas produced in Bandeirantes landfill, one of the biggest landfills in Brazil. This landfill is located in the metropolitan region of São Paulo, Brazil's biggest city and financial center of the country. With an estimated population of around 10 million citizens in 2000, São Paulo generates nearly 15,000 tons of waste daily. Bandeirantes Landfill Gas to Energy Project's goal is to explore the gas produced in Bandeirantes landfill, using it to generate electricity and flaring.

In the case of Bandeirantes, the landfill was originally conceived to make use of the best available technology at the time of its design, applying modern engineering techniques and environmental safety measures. That comprised landfill gas passive venting, with sporadic, inefficient flares in place as security measure. Therefore, a considerable amount of methane has been released to the atmosphere, as the flaring mechanism is capable of destroying only around 20% of the methane produced.

The situation described above doesn´t exist anymore. Since the Bandeirantes Landfill Gas To Energy Project has been implemented, the project avoid that methane previously released to the atmosphere will be burned either in flares or sent to the powerhouse, where the gas is used to generate energy. BLFGE Project reduce greenhouse gas emissions.

Bandeirantes Landfill Gas To Energy Project also avoid greenhouse gas emissions through grid electricity displacement. The methane extracted from the landfill is combusted to generate electricity which is going to feed the Brazilian grid. With that, emission reductions occur due to fossil-fueled energy generation displacement of the electric system.

The project started construction in 2003. The flaring system was installed in November, 2003 and the first gas engine was installed in December, 2003. The project activity started for tests in December 23rd 2003, when the final environmental license – working license – was issued. Officially, the project activity started, with the degassing station, in 01/01/2004 and, with the power plant, in 16/02/2004.

The Project presents two main units: the degassing installation and the power plant. The degassing station is responsible for the gas treatment, before sending it to the power plant. The equipments involved in this operation are: four heat exchange, four blowers, two flares and two chillers. The degassing station has installed seven flow meters[1], which are responsible for measuring the volume of gas extracted from the landfill. The power plant has a total of 24 Caterpillar engines, nominal capacity of 925 kWh installed, resulting in a total capacity of 22.2 MW.

[1] The seven installed flow meters are: FIR100 (total flow meter), FIR200 (flare flow meter), FIR700 (flare flow meter out of operation), FIR300, FIR400, FIR500 and FIR600 (engines flow meter).

This Monitoring Report refers to the 17th Monitoring Period that contains the period from November 1st, 2010 until December 22nd , 2010. The total emission reductions achieved in this Monitoring Period is given on the table below:

Total CO_2e from methane destroyed	38,522
Total CO_2e from electricity dispatched	2,294
TOTAL CO_2e	**40,816**

A.2. Project Participants

- Public entity: Prefeitura Municipal de São Paulo – Municipality of São Paulo
- Private entity: Biogás Energia Ambiental S.A.
- KfW Bankengruppe - Germany
- Mercuria Energy Trading S.A. – Switzerland
- Fortis Bank N.V/S.A. - Netherlands

A.3. Location of the project activity:

Bandeirantes Landfill Gas to Energy Project (BLFGE) is located between km 24 and km 26 at Bandeirantes highway, which connects the city of São Paulo with Campinas metropolitan region, the richest area of state of São Paulo. Landfill covers an area of approximately 1.35 million m2, having Perus urban area (a São Paulo district) as north border; São Paulo – Jundiai old road as east border; to the south lies the connection between this road and Bandeirantes highway; and finally to the west by Bandeirantes highway.

The project is located at Rua Mogeiro, 1580, Bairro Jardim Perus, São Paulo - Brazil. GPS coordinates from the location of the power house are the followings: Latitude - 23.419878°, Longitude - 46.756017°.

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A.4. Technical description of the project

Bandeirantes landfill is divided into 5 cells, named AS-1, AS-2, AS-3, AS-4 and AS-5. The former 3 are the oldest ones, which operated from 1978 until 1995. Bandeirantes Landfill Gas to Energy Project (BLFGE) has since its start been extracting gas from the newest cells, where there is still waste being disposed. Three main units can be detached: the substation, the degassing stations and the power plant.

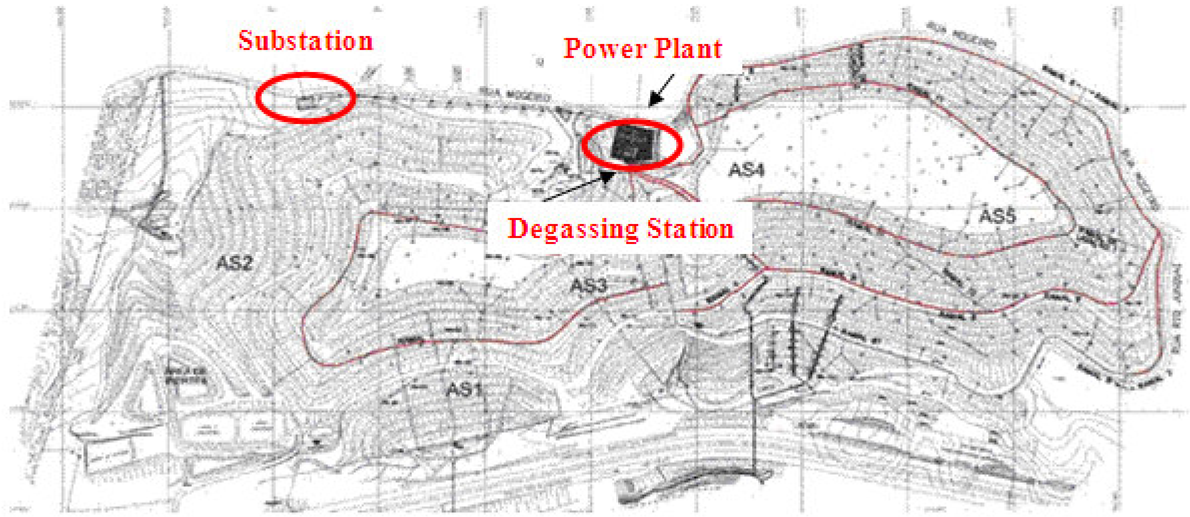


Figure 01 - Bandeirantes Landfill Cells

Roughly, the whole degasifying system, gas treatment and gas use can be described through the figure below.

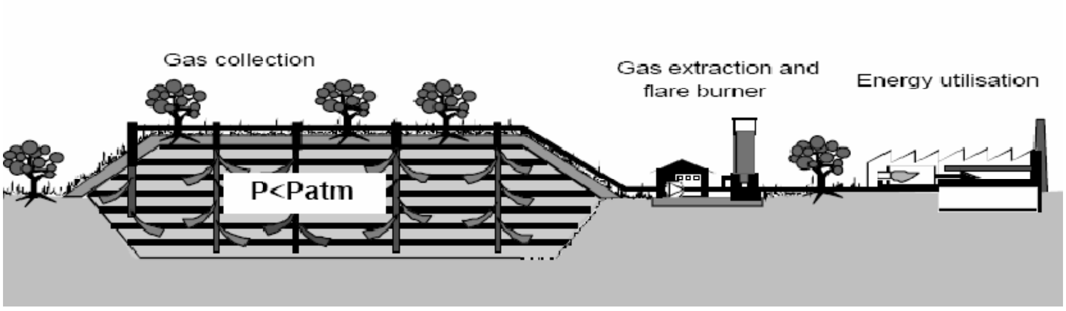


Figure 02 - Bandeirantes degasifying system

More technically, BLFGE Project can be seen as displayed in the figure below.

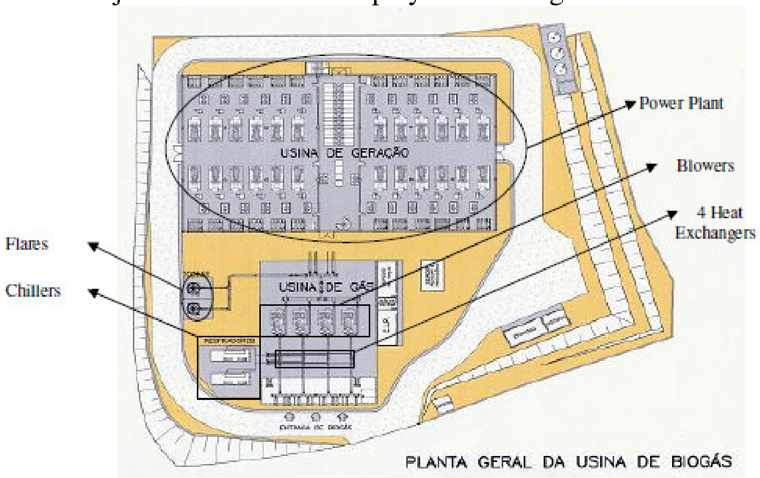


Figure 3 – Degassing installation and power plant.

From figure above, two main units can be detached: the degassing installations (USINA DE GÁS) and the power plant (USINA DE GERAÇÃO).

The degassing stations are responsible for extracting the landfill gas from the landfill and transport it to the gas engines in the power plant. During the transportation, the gas goes through a treatment to allow its use as fuel for energy generation. Other functions of the degassing stations are: drying landfill gas by gas coolers; and measuring and analyzing the quantity and quality of the landfill gas for safety, process and operating purposes.

Figure 4 - Degassing Station (A) and Power Plant (B)

The landfill gas cools down when transported from the landfill, resulting in a condensate. This is drained to condensate shafts, placed nearby the gas pipes. Once in the degassing stations, the landfill gas has to be cooled again to remove moisture. This is a very important step in the gas treatment process, since the condensate, which contains silicium components, could block the gas pipes and also damage the gas engines, due to the silicium. After this step, the gas is heated again through a second heat exchanger, or economizer, to a temperature of around 25ºC, far enough from the dew point of 4^{o}C to avoid further condensation.

Considering demoisturing is fundamental for the energy generation, as per the reasons mentioned in the previous paragraph, a demister has been installed for extra-safety reasons. The demister is a stainless steel high density filter which separates liquid particles (small amounts of condensate) from the landfill gas. This liquid is to be drained off to a condensate shaft as well.

The blowers are used for transportation of the landfill gas from the landfill to the gas engines, under correct suction and pre-pressure. Capacity and pressure are adjusted through frequency controlled electromotors. Moreover, the blowers are equipped with all the necessary safety equipment, including a noise reducing housing.

Figure 5 - Compressors (blue) and dryers (metal)

On the pressure side of the degassing station, all kinds of gas analyzing and gas measuring instruments are present. These instruments are very important for safety, process and operating purposes. After the described treatment, analyzing and measurement, the landfill gas is transported as a fuel to the gas

engines. These drive electrical generators in order to generate electrical power. An occasional surplus of the landfill gas can be burned off by the flares.

Figure 6 -. Turbine Flow-meter

Figure 7 - Generators used to produce electricity

Figure 8 - Flare used to destroy the surplus gas collected

For electricity generation, a total of 24 Caterpillar engines, nominal capacity of 925 kW, model G3516A were installed. They burn the gas and generate energy, which is to be sent to Eletropaulo's – the electric distributor supplying São Paulo metropolitan region – grid, measured at the substation. This electricity is in fact not be commercialized directly; it supplies Unibanco's branches over São Paulo state.

Nowadays about 09 Caterpillar engines are working in the power plant. This happens because the gas production in the landfill is lower nowadays.

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

The project's name is "Bandeirantes Landfill Gas to Energy Project" (BLFGE).

The methodology applied to Bandeirantes Landfill Gas To Energy Project is **ACM0001 – version 02**, called "Consolidated baseline methodology for landfill gas project activities". The applicability conditions for ACM0001 have already been considered under the baseline section of the PDD. In fact, BLFGE is a project activity undertaken with the purpose of capturing and flaring methane from landfill operations, and also using this methane as fuel for a power plant, generating electricity that will avoid fossil fuelled plants at the margin of the Brazilian electricity system, therefore causing a reduction in GHG emissions. ACM0001 is therefore fully applicable to BLFGE.

The Monitoring Plan was developed based on **ACM0001 - version 02** of the **"Consolidated monitoring methodology for landfill gas project activities"**.

A.6. Registration date of the project activity:

The date of registration of the project is 20/02/2006.

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

Bandeirantes Landfill Gas To Energy Project is in the first crediting period that had started on 23/12/2003. This period finished on 22/12/2010, because the project proponent has chosen a renewable crediting period of 7 years.

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

ARCADIS Tetraplan S.A.
Cíntia Philippi Salles / Juliana Justi Pedott
cintia.salles@tetraplan.com.br/juliana.justi@tetraplan.com.br
Avenida Nove de Julho, 5960/5966 – Jd. Paulistano
CEP 01406-200
São Paulo – SP - Brazil
Phone + 55 11 3060-8457
www.arcadis-global.com | www.tetraplan.com.br

Biogás Energia Ambiental S.A.
Antonio Carlos Delbin
delbin@biogas-ambiental.com.br
Rua Mogeiro, 1580 – Jardim Perus
CEP 05206-240
São Paulo – SP - Brazil
Phone + 55 11 3918-4833
www.biogas-ambiental.com.br

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

1) The starting date of operation of the project activity: the degassing station had started on 01/01/2004 and the power plant had started on 16/02/2004.

2) There was only one special event during this monitoring period.

Event	Description	How the event was considered
01	On November 19th, 2010, there was a problem in the Supervisory's hardware and the system has been out of operation up to December 29th, 2010; Sotreq has a supervisory system, responsible for storing and managing the central power generation, which is installed on a computer server. There was a widespread problem in the machine hardware, probably by the time of use, which affected the RAM memory and the motherboard of the server. Initially Sotreq tried to recover the server with replacement parts that were purchased, which required time of the arrest, but Sotreq has not succeeded and the machine was discarded. A new server was installed to carry the same functionality. At the same time a Schneider technical, supervisory system provider, was contracted to perform the installation of the system. Backups generated until the day before the problem had been recovered, but the production data generated during the interval of the problem were stored as a characteristic technique of its respective meter.	The event occurred was considered punctual by Sotreq because it had never happened before; It wasn't observed any impact related to the exported energy and the registered data of the exported energy during the period.

	The exported energy meters have mass memory, it means, they store internally the data generated daily. The hourly meters, from energy consumed in the degassing plant and in the power plant, does not have mass storage, i.e. only store the amount of time. Therefore, they are not able to provide the daily data. Thus, the exported energy data were retrieved normally. The daily data of the hour meter and energy consumption in degassing and power plants are represented only by the average amount of time divided by the number of days without the system.	

3) Nowadays about 09 Caterpillar engines are working in the power plant at the same time, although power plant has 24 engines installed. This happens because the gas production in the landfill is lower than the estimated in the PDD. The two flares, four blowers and two chillers installed were able to operate during the monitoring period, but because of the low gas production sometimes some of the equipment was not in operation.

No other events or rule/policy changes have taken place that could have affected the normal operation of the project and the applicability of the methodology.

B.2. Revision of the monitoring plan

A revision of the BLFGE Project monitoring plan was submitted to the EB 36th Meeting and approved on 29/01/2008 (http://cdm.unfccc.int/Projects/DB/DNV-CUK1134130255.56/view). The data to be collected or used to monitor emissions from the project activity, and how this data will be archived are presented in a table on item C.

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

During this monitoring period, no request for deviation has taken place.

B.4. Notification or request of approval of changes

Not applicable, as there has been no notification or request of approval of changes from the project activity as described in the registered CDM-PDD.

SECTION C. Description of the monitoring system

Monitoring Instruments:

The following instruments were installed in the Degassing Station, as per the revised Monitoring Plan:

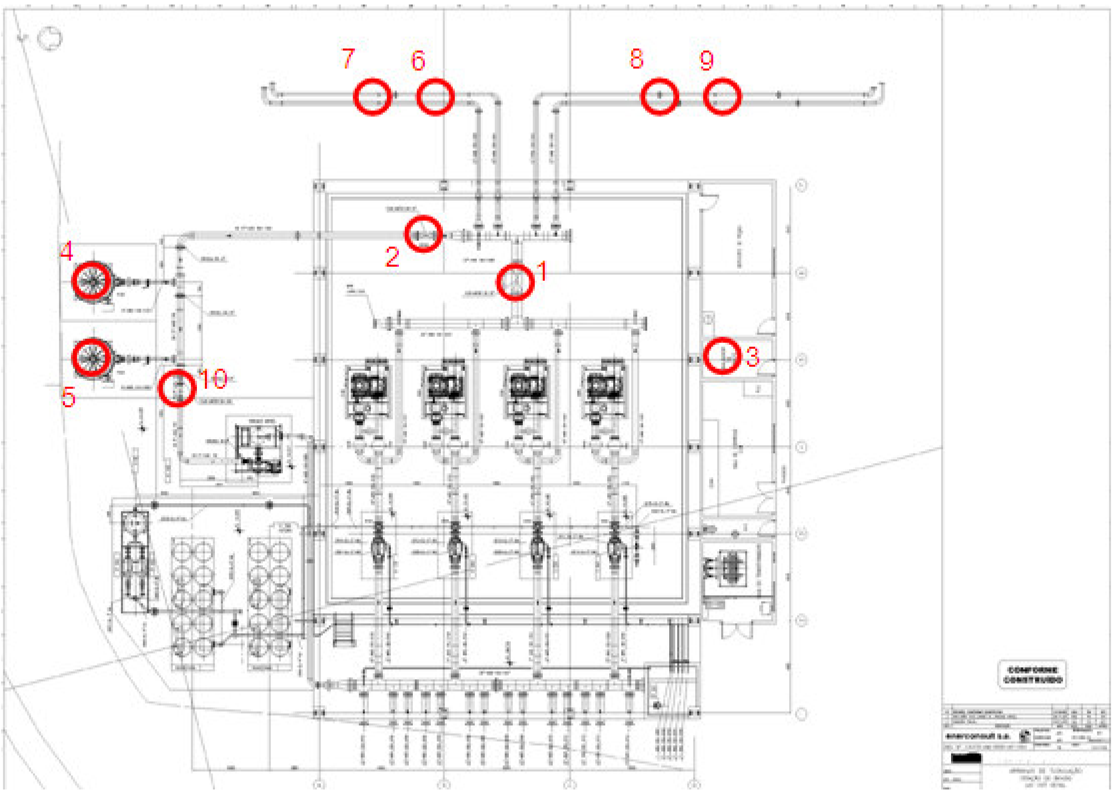


Figure 9 - Lay-out of the Degassing Station

1 – FIR100 – Flow meter: Register the total amount of landfill gas captured;
2– FIR200 - Flow meter: register the total amount of landfill gas flared;
3 – Gas Analyzer: Measure the Methane fraction in the landfill;
4 and 5 - Temperature meters of the exhaust gas - Flares F-100 and F-200, respectively;
6, 7, 8 and 9 - FIR300, FIR400, FIR500 and FIR600 – Flow meters: Registered the total amount of landfill gas combusted in the Power plant;
10 – FIR700 – Flow meter: Out of operation since 03/07/2009.

PDD ID	Data variable	Data Unit	Measured (M) Calculated (C) Estimated (E)	Recording frequency	Proportion of data to be monitored	Data achievement: Electronic (E) Paper (P)	For how long is archived data kept?	Comment
1 - $LFG_{Total, y}$	Total amount of landfill gas captured	Nm^3	M	Continuously	100%	E / P	During the crediting period and two years after	Measured by a flow meter. Data will be aggregated monthly and yearly. Normal cubic meters represent the gas volume in cubic meters at STP.
2 - $LFG_{Flare, y}$	Total amount of landfill gas flared	Nm^3	M	Continuously	100%	E / P	During the crediting period and two years after	Measured by a flow meter, located in the gas line. Normal cubic meters represent the gas volume in cubic meters at STP. Data will be aggregated monthly and yearly. After the installation of the mini-blower, the measurements will be made by two flow meters – the first one was presented above

PDD ID	Data variable	Data Unit	Measured (M) Calculated (C) Estimated (E)	Recording frequency	Proportion of data to be monitored	Data achievement: Electronic (E) Paper (P)	For how long is archived data kept?	Comment
								and the second one located in a dedicated line connected to a mini-blower. Normal cubic meters represent the gas volume in cubic meters at STP.
3 - $LFG_{Electricity, y}$	Total amount of landfill gas combusted in power plant	Nm^3	M	Continuously	100%	E / P	During the crediting period and two years after	Measured by 4 flow meters. Data will be aggregated monthly and yearly. Normal cubic meters represent the gas volume in cubic meters at STP.
4 - FE	Flare/combustion efficiency, determined by: the operation hours (1) and methane content in the exhaust gas (2)	%	M / C	(1) Continuously, (2) quarterly, monthly if unstable	N/A	E	During the crediting period and two years after	(1) Continuous measurement of operation time of flare (e.g. with temperature). (2) Periodic measurement of methane content of flare exhaust gas.

PDD ID	Data variable	Data Unit	Measured (M) Calculated (C) Estimated (E)	Recording frequency	Proportion of data to be monitored	Data achievement: Electronic (E) Paper (P)	For how long is archived data kept?	Comment
5 - $w_{CH4,\ y}$	Methane fraction in the landfill gas	%	M	Continuously	100%	E	During the crediting period and two years after	Measured by continuous gas quality analyzer.
6	Regulatory requirements relating to landfill gas projects	Test	N/A	Annually	100%	E	During the crediting period and two years after	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$
7 - EG_y[2]	Net Electricity Exported to the Grid	MWh	M	Continuously	100%	E	During the crediting period and two years	The net quantity of electricity displaced will be measured by an electricity meter. BLFGE Project will measure the total electricity fed into the grid (via an electricity-meter).
8 - EF_y[2]	Emission Factor	tCO_2/MWh	C	At baseline renewal	100%	E	During the crediting period and two years	This data will be updated at the baseline renewal, in accordance with the considered methodology.

[2] Monitoring parameters as per methodology ACM0002 – version 03 to calculate emission reductions due to the displacement of fossil-fuel based energy in the Brazilian S-SE-CO Grid.

Data Acquisition:

All variables monitored are controlled by an electrical control system. This control system is provided with a PLC (Programmable Logical Computer). All the measured process signals are processed by the PLC to output signals for the gas-coolers, blowers, flares and gas-engines. Also the system counts on a SCADA system (process visualization on a personal computer). With this system it is possible to control and monitor the installation at a distance, including through the internet.

Figure 10 - PLC Controlling System panel

For each parameter operationally monitored, the PLC makes a routine of reading / transmitting / registering in the Supervosory's System hard disk as presented in the figure below:

READING → **TRANSMITION TO THE PLC** → **REGISTRATION**

Device (flow-meter, methane analyzer, temperature & pressure sensors)

Electric signal

Supervisory System's hard disk – SQL Database

Depending on the parameter, the frequency of the PLC's routine may vary, as presented in the table below:

Methodology ID	Equipment TAG	Reading Frequency	Transmition Frequency	Registration Frequency	Comments
$LFG_{Total, y}$	FIR100	Continuously	Continuously	Every 5 minutes	- Data accumulated every 1 hour is registered in the SQL's database, in Nm^3; - Every 00:00, the PLC's counter is reseted; - The flow-computer installed in the flow-meter keeps registering the accumulated flow; - Every 00:00, the accumulated flow (in Nm^3) is manually registered by the operators; - Every 3 hours, the operators perform the "Print-Screen" of the controlling system panel; - Responsibilities of the routine: PLC (continuously) and plant supervisor (monthly)
$LFG_{Flare, y}$	FIR200 FIR700	Continuously Out of operation	Continuously Out of operation	Every 5 minutes Out of operation	
$LFG_{Electricity, y}$	FIR300 FIR400 FIR500 FIR600	Continuously Continuously Continuously Continuously	Continuously Continuously Continuously Continuously	Every 5 minutes Every 5 minutes Every 5 minutes Every 5 minutes	

Methodology ID	Equipment TAG	Reading Frequency	Transmition Frequency	Registration Frequency	Comments
FE_{F100}	(1) TAC520 (2) N/A	(1) Continuously (2) Every 3 months, by a specialized company on gas analysis	(1) Continuously (2) Every 3 months, by a specialized company on gas analysis	(1) Every 5 minutes (2) Every 3 months, by a specialized company on gas analysis	- Temperatures below 900°C indicates that the flare is running out of the specified combustion temperature range; - A sudden decrease of temperature indicates that the main valve of the flare is closed and no gas is being sent to the flare (please, refer to item 3.1.1) - The methane analysis in the exhaust gas is made according with internal procedures from the hired company
FE_{F200}	(1) TAC570 (2) N/A	(1) Continuously (2) Every 3 months, by a specialized company on gas analysis	(1) Continuously (2) Every 3 months, by a specialized company on gas analysis	(1) Every 5 minutes (2) Every 3 months, by a specialized company on gas analysis	
$w_{CH4, y}$	A100	Continuously	Continuously	Every 5 minutes	- By the end of the day, an average of CH_4 concentration (registered every 5 minutes) is calculated. - Responsibilities of the routine: PLC (continuously) and plant supervisor (monthly)
EG_y	N/A	Continuously	Continuously	Every 15 minutes	- Sotreq's PLC registers the accumulated electricity sent to the grid every 00:00. Data is compared with Eletropaulo's invoices. - Responsibilities of the routine: PLC (continuously) and Sotreq's plant supervisor (monthly)

<u>Involvement of third parties:</u>

BFLGE has three third parties involved:

- Specialized company on gas analysis, to perform the analysis of methane concentration in the exhaust gas. For this monitoring period, Biogás hired CORPLAB, a certified national laboratory.
- Sotreq, the company responsible for the electricity production in the power house, using the gas from the landfill. Sotreq's PLC is responsible to monitor the electricity displaced to the local grid.
- ARCADIS Tetraplan is the company responsible to develop the Monitoring Report and is part of the quality assurance/quality control procedures.

<u>Quality assurance and quality control measures:</u>

Internal Procedures of ISO 14001

Biogás counts with the internal procedure SGA IT 4.4.6-26 which objective is to specify the monitoring procedures made inside the Degassing Station, as gas flows, temperature, pressure, electricity generation and methane concentration.

As presented in item Data Acquisition, all parameters monitored inside the Degassing Station have the same reading / transmitting / registration routine and all routines have one person responsible: the plant supervisor.

Every week, the plant supervisor downloads all data registered from the PLC and makes a complete check to identify unconformities, such as unread registrations or troubles with the PLC (this unconformities happens mainly due to electricity black-outs). All unconformities raised are promptly compared with operational events, registered by the operators in the Operation Diary. The event is informed to the Production Manager of Biogás, which is responsible for taking the necessary actions to avoid it to happen again.

In order to avoid data loss, the operators are oriented to register all gas flow data manually in proper sheets on a daily basis (0:00 hour), which are verified by the production manager weekly for legibility. Additionally, the operators are oriented to perform, every three hours, the “Print-Screen” of the control system panel of the PLC. The picture is saved in the computer’s hard-disk.

Also, the BLGFE count with a third-party, non-responsible for the project’s monitoring: ARCADIS Tetraplan, which is the responsible for the development of the Monitoring Report. ARCADIS Tetraplan’s role in the Project is to assure the quality of the registered data, through a double-check process, and to assure the quality of the calculation of ERs and is in constant contact with the Production Manager of Biogás.

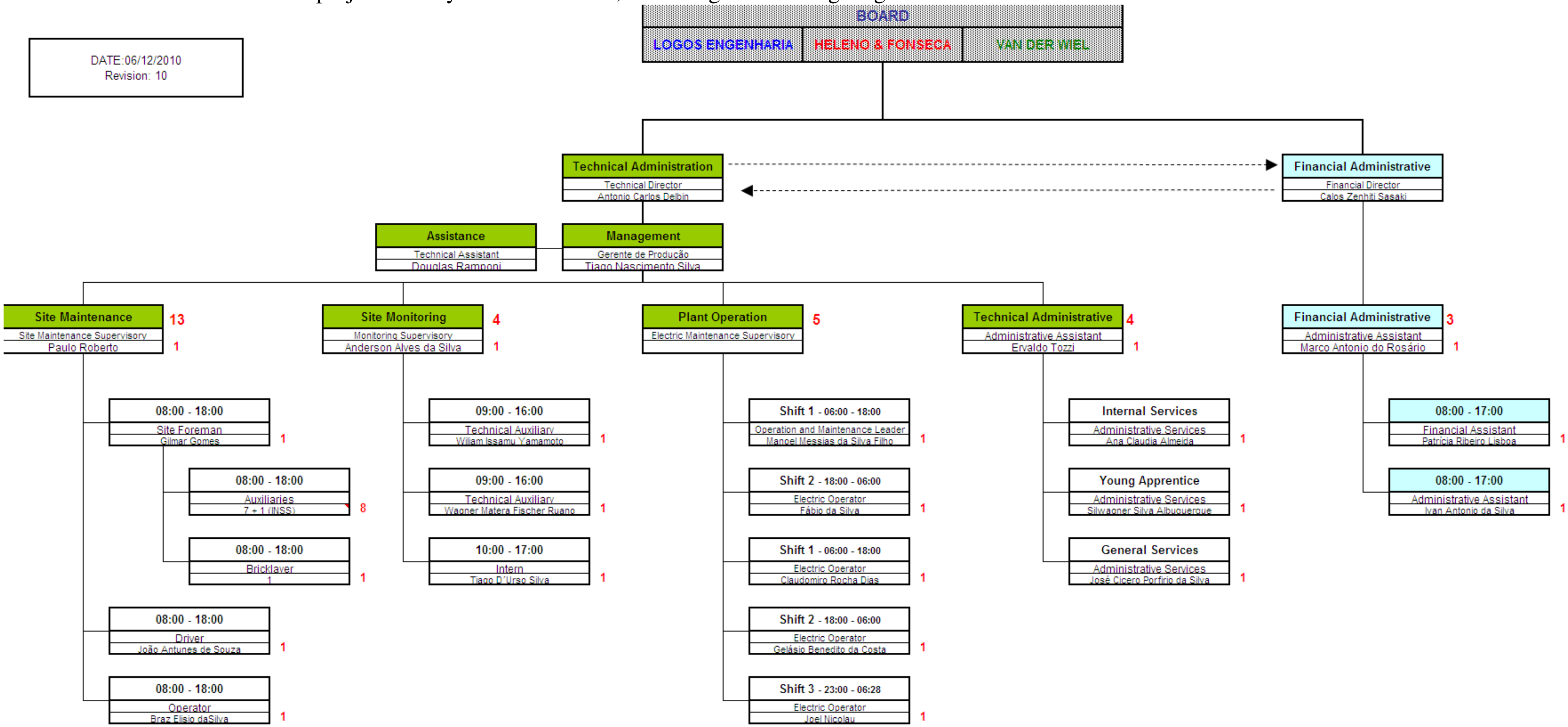
Moreover, Biogás was certified with ISO 14001 in 04/11/2008. With this certification, errors will be minimized through reinforcement of the procedures, such as:

- Document Control;
- Data safety measures (backup and sabotage);
- Monitoring Report Preparation (frequency, responsibilities, crosschecking measures, legal binding signature in monitoring reports, etc.);
- Data Spreadsheets;
- Error management (including software errors, material errors, etc.);

Biogás underwent an annual follow-up audit of ISO 14001 certification, in 14 and 15/10/2010.

<u>Organizational Structure, responsibilities and competencies:</u>

Positions and roles for this CDM project activity are well defined, according with the organogram below:



Obs.: In the Plant Operation boxes, the last box is empty because one operator doesn't work in Biogás anymore. However, Biogás is planning to hire another operator to work in this shift.

Figure 11 - General Organogram of Biogás

From the point of view of the plant operation, positions and roles are defined. Duties, personnel replacement in the case of non-availability of the supervisor of monitoring and/or the electrical supervisor and hiring requirements for job positions are determined in documented procedures, as presented in the figures below:

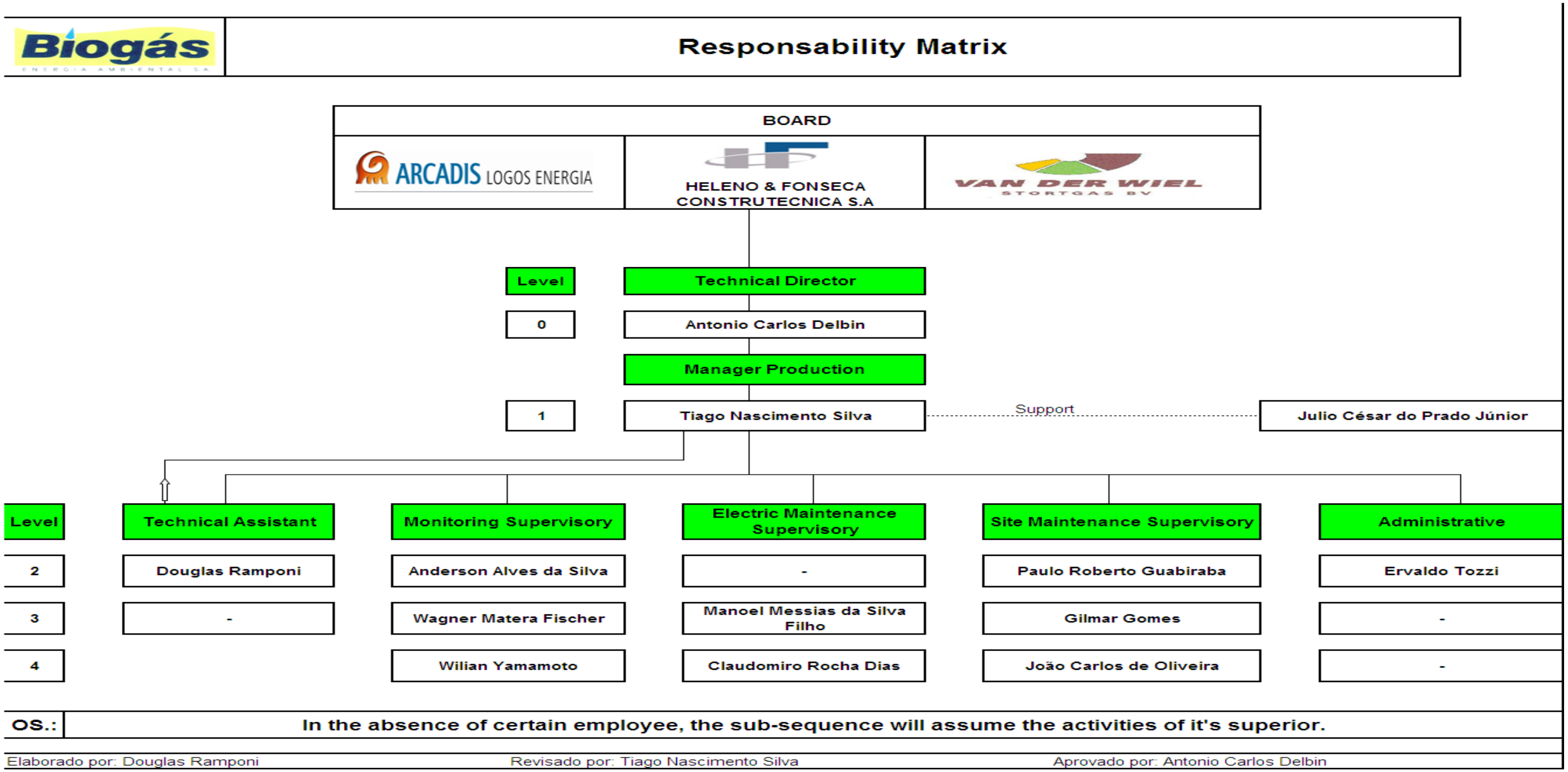


Figure 12 - Responsibility Matrix of Biogás Energia Ambiental

Trainings:
All training was supplied to operator before the project's implementation. The training certificate was presented to the Verification Team.

For this monitoring period, two new employees were hired: Joel Nicolau to work as Electric Operator and Silwagner Silva de Albuquerque to work as Young Apprentice.

The new operator realized the training in the following period: 08/11/2010 to 19/11/2010.

Data protection measures:
As all data registered in the Supervisory System's hard disk is subjected to sabotage and technical failure, Biogás developed the following actions to protect the monitoring system:

- The PLC is not connected to the Internet, thus the risk of virus is minimized;
- Only defined persons have access to the data base of the system;
- Antivirus programmes are installed at the system;
- Data backup:
  - A weekly CD backup of the Supervisory System's hard disk;
  - A weekly backup of the Supervisory System's hard disk is made by the server of Heleno & Fonseca (one of Biogás shareholders);
  - Van der Wiel (another Biogás shareholder) has radio access to the Supervisory System, via a CARS (Central Alarming and Registration System);

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:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential value for methane
Source of data used:	1996 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**$\rho_{CH4,n,h}$**
Data unit:	tCH_4/m^3CH_4
Description:	Density of methane gas at standard temperature and pressure
Source of data used:	1996 IPCC Guideline for National Greenhouse Gas Inventory
Value(s) :	0.0007168
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**(ID – 8) EF**
Data unit:	tCO2e/MWh
Description:	CO_2 emission intensity of the electricity
Source of data used:	Brazilian Grid
Value(s) :	0.2677
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**AF**
Data unit:	%
Description:	Adjustment Factor
Source of data used:	PDD Registered
Value(s) :	20
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline calculation
Additional comment:	N/A

D.2. Data and parameters monitored

Data / Parameter:	**(ID – 1) $LFG_{Total, y}$**
Data unit:	Nm³
Description:	Total amount of landfill gas captured from the landfill site in normal cubic meters at standard temperature and pressure
Measured /Calculated /Default:	Measured
Source of data:	PLC data records
Value(s) of monitored parameter:	These values are indicated in table E.1.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	The data flow generated from FIR100 is actually used on purpose to realize the cross checking of flow from the other flow meters. These values of the total gas flow are not used to calculate the amount of CERs.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(see table below)
Measuring/ Reading/ Recording frequency:	Data is continuously measured by a flow meter. Measurements of the flow are recorded electronically by PLC at least each five minutes and the hourly value is accumulated. The data is archived electronically. The

Equipment	TAG	Manufacturer	Model	Serial Number	Error (%)	Date of the last calibration	Date of the next calibration
Turbine Flow-meters	FIR100	Endress + Hauser	t-mass 65 I DN175 / 7" (177.75 mm)	9407D902000	0.06	25/04/2007	25/04/2012

	reading frequency is continuously and registered by the PLC.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	The procedure SGA IT 4.4.6-29 explains that the operator must check the operational conditions for all the equipments/instruments, at least once a day. In the flow meters case if the operator identifies some problem, the instrument must be replaced or calibrated. If the operator doesn't find any abnormality, the instrument will be calibrated or replaced by another one already calibrated every five years.

<table>
<tr><td>Data / Parameter:</td><td>(ID - 2) LFG$_{Flare, y}$</td></tr>
<tr><td>Data unit:</td><td>Nm^3</td></tr>
<tr><td>Description:</td><td>Amount of landfill gas captured from the landfill site in normal cubic meters at standard temperature and pressure</td></tr>
<tr><td>Measured /Calculated /Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>PLC data records</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>These values are indicated in table E.1.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Equipment</th><th>TAG</th><th>Manufacturer</th><th>Model</th><th>Serial Number</th><th>Error (%)</th><th>Date of the last calibration</th><th>Date of the next calibration</th></tr>
<tr><td rowspan="2">Turbine Flow-meters</td><td>FIR200</td><td>Incontrol</td><td>VTGE X-200</td><td rowspan="2">VG15239</td><td>0.89</td><td>01/07/09</td><td>01/07/14</td></tr>
<tr><td>FIR700</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">Pressure Transmitter</td><td>FIR200</td><td>SMAR</td><td>LD291 M</td><td>L454793/L42236</td><td>0.0851</td><td>27/03/09</td><td>27/03/14</td></tr>
<tr><td>FIR700</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td rowspan="2">Temperature Transmitter</td><td>FIR200</td><td>ASTA</td><td>PT-100</td><td>S377815</td><td>0.6471</td><td>26/03/09</td><td>26/03/14</td></tr>
<tr><td>FIR700</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Data is continuously measured by a flow meter. Measurements of the flow are recorded electronically by PLC at least each five minutes and the hourly value is accumulated. The data is archived electronically. The reading frequency is continuously and registered by the PLC.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</td></tr>
<tr><td>QA/QC procedures applied:</td><td>The procedure SGA IT 4.4.6-29 explains that the operator must check the operational conditions for all the equipments/instruments, at least once a day. In the flow meters case if the operator identifies some problem, the instrument must be replaced or calibrated. If the operator doesn't find any abnormality, the instrument will be calibrated or replaced by another one already calibrated every five years.</td></tr>
</table>

Data / Parameter:	**(ID -3) LFG$_{Electricity, y}$**

<table>
<tr><td>Data unit:</td><td>Nm³</td></tr>
<tr><td>Description:</td><td>Amount of landfill gas captured from the landfill site in normal cubic meters at standard temperature and pressure</td></tr>
<tr><td>Measured /Calculated /Default:</td><td>Measured by four flow meters</td></tr>
<tr><td>Source of data:</td><td>PLC data records</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>These values are indicated in table E.1.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Equipment</th><th>TAG</th><th>Manufac turer</th><th>Model</th><th>Serial Number</th><th>Error (%)</th><th>Date of the last calibration</th><th>Date of the next calibrati on</th></tr>
<tr><td rowspan="4">Turbine Flow-meters</td><td>FIR300</td><td rowspan="4">Incontrol</td><td rowspan="4">VTGE X-200</td><td>VG083B6</td><td>0.772</td><td rowspan="4">12/12/06</td><td rowspan="4">12/12/11</td></tr>
<tr><td>FIR400</td><td>VG084B6</td><td>0.596</td></tr>
<tr><td>FIR500</td><td>VG086B6</td><td>0.632</td></tr>
<tr><td>FIR600</td><td>VG085B6</td><td>0.811</td></tr>
<tr><td rowspan="4">Pressure Transmitter</td><td>FIR300</td><td rowspan="4">SMAR</td><td rowspan="4">LD291 M</td><td>33007-06</td><td>0.0567</td><td>06/05/09</td><td>06/05/14</td></tr>
<tr><td>FIR400</td><td>L454794/L42 237</td><td>0.0317</td><td>27/03/09</td><td>27/03/14</td></tr>
<tr><td>FIR500</td><td>33006-06</td><td>0.0417</td><td>23/06/09</td><td>23/06/14</td></tr>
<tr><td>FIR600</td><td>33005-06</td><td>0.0417</td><td>17/04/08</td><td>17/04/13</td></tr>
<tr><td rowspan="4">Temperature Transmitter</td><td>FIR300</td><td rowspan="4">ASTA</td><td rowspan="4">PT-100</td><td>S502986</td><td>0.5993</td><td rowspan="4">26/03/09</td><td rowspan="4">26/03/14</td></tr>
<tr><td>FIR400</td><td>S502987</td><td>0.1775</td></tr>
<tr><td>FIR500</td><td>S502988</td><td>0.8717</td></tr>
<tr><td>FIR600</td><td>S502989</td><td>0.1998</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Data is continuously measured by a flow meter. Measurements of the flow are recorded electronically by PLC at least each five minutes and the hourly value is accumulated. The data is archived electronically. The reading frequency is continuously and registered by the PLC.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</td></tr>
<tr><td>QA/QC procedures applied:</td><td>The procedure SGA IT 4.4.6-29 explains that the operator must check the operational conditions for all the equipments/instruments, at least once a day. In the flow meters case if the operator identifies some problem, the instrument must be replaced or calibrated. If the operator doesn't find any abnormality, the instrument will be calibrated or replaced by another one already calibrated every five years.</td></tr>
</table>

Data / Parameter:	**(ID – 4) FE_{F100}**
Data unit:	(1) °**C** (2) mg/Nm^3
Description:	(1) Temperature of the exhaust gas in the flare F100 (2) Methane content of flare exhaust gas.
Measured /Calculated	(1) Measured

<table>
<tr><td>/Default:</td><td>(2) Measured/calculated</td></tr>
<tr><td>Source of data:</td><td>(1) PLC data records
(2) Analysis made by a third party.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>These values are indicated in table E.1.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Equipment</th><th>TAG</th><th>Manufacturer</th><th>Model</th><th>Serial Number</th><th>Error (%)</th><th>Date of the last calibration</th><th>Date of the next calibration</th></tr>
<tr><td>(1) Thermocouple</td><td>(1) TAC520</td><td>(1) Jumo</td><td>(1) type "S" L750</td><td rowspan="2">(1) 32950/030</td><td rowspan="2">N/A</td><td rowspan="2">N/A</td><td rowspan="2">N/A</td></tr>
<tr><td>(2) Chromatographer – analysis made by a Third Party</td><td>(2)N/A</td><td>(2) N/A</td><td>(2) N/A</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>(1) Data is measured by a thermometer installed in the flare and the reading frequency is continuously. Measurements of the temperature of the exhaust gas are recorded electronically by PLC at least each five minutes and once per hour. The data is archived electronically.
(2) The data is measured with a chromatographer each three months by a specialized lab – CORPLAB, as explained on item E.1.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>(1) N/A
(2) Flare Efficiency Spreadsheet.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Regular maintenance will ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values. This is mentioned in the procedure SGA IT 4.4.6-10 and explains how the maintenance and testing are realized. The operation team is responsible for the testing/maintenance, following the procedure mentioned above. The operation team performs a daily check list of equipment and components to detect possible defects. When an abnormality is noticed, the maintenance is performed or, in some cases, occurs a replacement of the device that failed.</td></tr>
</table>

Data / Parameter:	**(ID – 4) FE_{F200}**
Data unit:	**(1)** °C **(2)** mg/Nm^3
Description:	(1) Temperature of the exhaust gas in the flare F200 (2) Methane content of flare exhaust gas.
Measured /Calculated /Default:	(1) Measured (2) Measured/calculated
Source of data:	(1) PLC data records (2) Analysis made by a third party.

<table>
<tr><td>Value(s) of monitored parameter:</td><td>These values are indicated in table E.1.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th>Equipment</th><th>TAG</th><th>Manufacturer</th><th>Model</th><th>Serial Number</th><th>Error (%)</th><th>Date of the last calibration</th><th>Date of the next calibration</th></tr>
<tr><td>(1) Thermocouple</td><td>(1) TAC570</td><td>(1) Jumo</td><td>(1) type "S" L750</td><td rowspan="2">(1) 32411/030</td><td rowspan="2">N/A</td><td rowspan="2">N/A</td><td rowspan="2">N/A</td></tr>
<tr><td>(2) Chromatographer – analysis made by a Third Party</td><td>(2)N/A</td><td>(2) N/A</td><td>(2) N/A</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>(1) Data is measured by a thermometer installed in the flare and the reading frequency is continuously. Measurements of the temperature of the exhaust gas are recorded electronically by PLC at least each five minutes and once per hour. The data is archived electronically.
(2) The data is measured with a chromatographer each three months by a specialized lab – CORPLAB, as explained on item E.1.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>(1) N/A
(2) Flare Efficiency Spreadsheet.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Regular maintenance will ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values. This is mentioned in the procedure SGA IT 4.4.6-10 and explains how the maintenance and testing are realized. The operation team is responsible for the testing/maintenance, following the procedure mentioned above. The operation team performs a daily check list of equipment and components to detect possible defects. When an abnormality is noticed, the maintenance is performed or, in some cases, occurs a replacement of the device that failed.</td></tr>
</table>

Data / Parameter:	**(ID – 5) $W_{CH4,y}$**
Data unit:	**m^3CH_4/m^3LFG**
Description:	Methane fraction in the landfill gas.
Measured /Calculated /Default:	Measured
Source of data:	PLC data records.
Value(s) of monitored parameter:	These values are indicated in table E.1.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial	Manufacturer: Rosemount - NUK Type: Binos 100

number, calibration frequency, date of last calibration, validity)	TAG: A100 Accuracy class: 1.0000% (error) Serial number: 99965398 Calibration frequency: weekly, with a standard gas Date of last calibration: not applicable Validity: not applicable
Measuring/ Reading/ Recording frequency:	The data is continuously measured by the gas analyzer and recorded electronically by PLC at least each five minutes and once per hour, instantaneously. The reading frequency is continuously and registered by the PLC.
Calculation method (if applicable):	N/A.
QA/QC procedures applied:	The gas analyzer will be subject to a regular maintenance and testing regime to ensure accuracy. This is mentioned in the procedure SGA IT 4.4.6-10 and explains how the maintenance and testing are realized. The operation team is responsible for the testing/maintenance following the procedure mentioned above. The operation team performs a daily check list of the instrument to detect leaks and other defects. The filter replacement is performed when the team deems necessary. The calibration is also performed to detect possible flaws in the gas analyzer.

Data / Parameter:	**(ID – 6) Regulatory requirements**
Data unit:	Test
Description:	Regulatory requirements relating to landfill gas projects
Measured /Calculated /Default:	N/A
Source of data:	National environmental legislation and data base “Green Solution”
Value(s) of monitored parameter:	Required for any changes to the adjustment factor (AF) or directly MDreg,y
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	The recoding frequency is yearly.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$

Data / Parameter:	**(ID – 7) EG_y**
Data unit:	**MWh**
Description:	Net quantity of electricity delivered to the grid which is produced by using LFG under the project activity.

Measured /Calculated /Default:	Measured
Source of data:	PLC data records
Value(s) of monitored parameter:	See section E.1.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Manufacturer: Merlin Gerin Type: Power Logic – CM4000 TAG: Not applicable Accuracy class: 1.0000% (error) Serial number: 0011001414 Calibration frequency: 2 years Date of last calibration: 30/10/2009 Validity: 30/10/2011[3]
Measuring/ Reading/ Recording frequency:	The data is measured by electricity meter installed at the project site and the connected substation. The reading frequency from the electricity meter is continuously The data is registered every 15 minutes and hourly in the SOTREQ´s PLC database and aggregated monthly. The data is monitored and archived electronically. AES Eletropaulo sends the registered data for Sotreq and Biogás. Double-check by electricity generated is realized and the lower values between Sotreq PLC data records and AES Eletropaulo sales receipt data are used for the CER calculation.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	If Sotreq operator identifies some problem, the instrument must be replaced or calibrated. If the operator doesn't find any abnormality, the instrument will be calibrated or replaced by another one already calibrated each two years. However according to Sotreq it is very easy to identify if the instrument is not working because it can be checked by the daily registered data and the monthly production sheet.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

In BLFGE Project, the Baseline Emissions Calculation is the same value than the Emission Reductions Calculation, because there are neither project nor leakage emissions, as explained in the next items.

Consequently, to calculate the baseline emissions to BLFGE Project we adopted the same formula as for the emission reductions calculation, as presented below:

[3] Biogás adopted two years instead of five years in order to be conservative, because Eletropaulo calibrates the electric meters in this frequency.

According with baseline methodology ACM0001 – version 02, Emission Reductions are calculated as follows:

$$ER_y = (MD_{project,\,y} - MD_{reg,\,y}) \times GWP_{CH4} + EG_y \times CEF + ET_y \times CEF_{thermal,\,y} \quad (1)$$

Where:
ER_y = Emission reductions achieved by the project activity during a given year y (tCO_2e);
$MD_{project,\,y}$ = Amount of methane actually destroyed/combusted during the year y (tCH_4);
$MD_{reg,\,y}$ = Amount of methane that would have been destroyed/combusted during the year y in the absence of the project activity (tCH_4);
GWP_{CH4} = Global Warming Potential value for methane (tCO_2e/tCH_4);
EG_y = Net quantity of electricity displaced during the year y (MWh)
$CEF_{electricity,\,y}$ = CO_2 emissions intensity of the electricity displaced (tCO_2e/MWh)
ET_y = Quantity of thermal energy displaced during the year y (TJ)
$CEF_{thermal,\,y}$ = CO_2 emissions intensity of the thermal energy displaced (tCO_2e/TJ).

$CEF_{thermal,\,y}$= 0, because BLFGE Project does not displace thermal energy.
$MD_{project,\,y}$ is calculated as the sum of methane flow destroyed in the flares, in the power house and in the heat generation, as follows:

$$MD_{project,\,y} = MD_{flared,\,y} + MD_{electricity,\,y} + MD_{thermal,\,y} \quad (2)$$

Where:
$MD_{flared,\,y}$ = quantity of methane destroyed in the flares in year y (tCH_4)
$MD_{electricity,\,y}$ = quantity of methane destroyed by the generation of electricity y (tCH_4);
$MD_{thermal,\,y}$ = quantity of methane destroyed for the generation of thermal energy in year y (tCH_4)

As the BLFGE Project does not use the methane to generate thermal energy, $MD_{thermal,\,y} = 0$.

$MD_{flared,\,y}$ is calculated as follows:

$$MD_{flared,\,y} = LFG_{flared,\,y} \times w_{CH4} \times D_{CH4} \times FE \quad (3)$$

Where:
$MD_{flared,y}$ = Quantity of methane destroyed by flaring (tCH_4);
$LFG_{flare,y}$ = Quantity of landfill gas flared during the year measured in cubic meters (Nm^3);
$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (m^3_{CH4}/m^3LFG)
FE = Flare efficiency (%);
D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3_{CH4});

$MD_{electricity,\,y}$ is calculated as follows:

$$MD_{electricity,\,y} = LFG_{electricity,\,y} \times w_{CH4} \times D_{CH4} \quad (4)$$

Where:
$MD_{electricity,y}$ = Quantity of methane destroyed by generation of electricity (tCH_4);

$LFG_{electricity,y}$ = quantity of landfill gas fed into electricity generator (Nm^3);
$w_{CH4,y}$ = Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (m^3_{CH4}/m^3LFG)
D_{CH4} = Methane density expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3_{CH4});

Thus, $MD_{project,\ y}$ is equal to:

$$MD_{project,\ y} = \left(LFG_{flared,\ y} \times w_{CH4} \times D_{CH4} \times FE\right) + \left(LFG_{electricity,\ y} \times w_{CH4} \times D_{CH4}\right) \quad (5.1)$$

$$MD_{project,\ y} = w_{CH4} \times D_{CH4} \times \left(LFG_{flared,\ y} \times FE + LFG_{electricity,\ y}\right) \quad (5.2)$$

The amount of methane that would have been destroyed/combusted during the year *y* in the absence of the project activity ($MD_{reg,\ y}$) is calculated adopting an “Adjustment Factor” (AF), as no regulatory or contractual requirements specifying a quantity of methane destruction exists. As will be presented below, the *AF* adopted for the 1st Crediting Period is equal to 20% of total gas collected. Thus, equation (1) is updated to:

$$\mathbf{ER_y = \left(MD_{project,\ y} - 0.2 \times MD_{project,\ y}\right) \times GWP_{CH4} + EG_y \times CEF} \quad (6.1)$$

$$\mathbf{ER_y = \left(0.8 \times MD_{project,y}\right) \times GWP_{CH4} + EG_y \times CEF} \quad (6.2)$$

A description and consideration of measurement uncertainties and error propagation will be presented and detailed along this item.

Calculation of FE – Flare Efficiency:

To calculate the Flare Efficiency, the following formulae were applied, based on the mass-balance (an Excel spreadsheet was evidenced to the Verification Team):

Calculate the volume of CH_4 sent to flares F_i ($Flow_{methane}$), measured by the equipment FIR_i:

$$Flow_{methane} = Flow_{FIR\,i} \times \frac{\%_{methane}}{100}$$

Where:

- $Flow_{methane}$ = methane flow sent to the flare Fi (Nm^3/h);
- $Flow_{FIRi}$ = total flow measured by the flow-meter FIRi sent to the flare F_i (Nm^3/h);
- % methane = methane measured by the gas analyzer (%);

Calculate the volume of other gases (residual gases) sent to flares ($Flow_{remaining}$):

$$Flow_{remaining} = Flow_{FIR\,i} - Flow_{methane}$$

Where:

- $Flow_{remaining}$ = flow of residual gases sent to the flare F_i (Nm^3/h);

Calculate the total flow entering the flare F_i ($Flow_{Total}$):

$$Flow_{Total} = Flow_{methane} + \left(Flow_{methane} \times air_{ratio}\right) + Flow_{remaining}$$

Where:

- $Flow_{total}$ = total gas sent to the flare F_i (Nm^3/h);
- air_{ratio} = theoretical air ratio[4];

Calculate the mass of methane in the exhaust gas ($M_{methane}$):

$$M_{methane} = Flow_{Total} \times \frac{CH_{4,eg}}{1000}$$

Where:

- $M_{methane}$ = amount of methane remaining in the exhaust gas (g), calculated using the result of the analysis;
- $CH_{4,eg}$ = methane concentration in the exhaust gas (mg/Nm^3) – data acquired from the analysis form the specialized company;

Calculate the Flare Efficiency (FE):

$$FE = \frac{\left(Flow_{methane} \times 0.7168\right) - \dfrac{M_{methane}}{1000}}{\left(Flow_{methane} \times 0.7168\right)} \times 100$$

Where:

- FE = Flare Efficiency (%);
- 0.7168 = density of methane, at STP (kg/Nm^3).

CORPLAB made two analyses of the methane content in the exhaust gas of the flares F100 and F200 in 21/10/2010.

Flare	October/2010[5]
F100	1.00 mg/Nm^3
F200	2.10 mg/Nm^3

[4] Air_{ratio} is equal to 5, as recommended by Hoffstetter, the flare manufacturer.

[5] The values presented from the analysis of October/2010 correspond to the highest value detected among 13 measurements.

Other parameters used to calculate the flare efficiency were:

Measurement	$Flow_{FIRi}$		Methane %	
	F100	F200	F100	F200
October/2010	328.00 Nm^3/h	1,237.00 Nm^3/h	47.3%	47.6%

The results were:

Measurement	Flare Efficiency Calculated	
	F100	F200
October/2010	99.9990%	99.9979%

The flare efficiency assumed from 01/11/2010 to 22/12/2010 was 99.9979% (the lowest efficiencies calculated).

Monitoring of the operation time of the flares is made continuously by the PLC and every 5 minutes the instantaneous temperature is registered by the supervisory system. In order to guarantee the real destruction of the gas, the flares are equipped with an automatic system which can detect the existence of flame. The following operational procedure is applied:

- a signal of gas being collected is sent to the PLC, which sends a signal to a solenoid valve;
- the valve is opened and a small amount of gas is delivered to an ignition burner;
- the ignition burner ignites the gas;
- an UV-sond (part of the ignition burner) verifies the existence of an stable flame – if not, the flare is stopped;
- if the stable flame detection is successful, the UV-sond sends a signal to the PLC, which then opens the main valve, located in the entrance of the flare;
- the main burner is ignited and gas began to be destroyed;
- after a few seconds, the ignition burner is switched off and UV-sond began to monitor the existence of flame in the flare – if no flame is detected, the flare will be automatically stopped by a signal sent from the UV-sond to the PLC;

According with the manufacturer, if the temperature of the flare is higher than 1,350°C, the flare will be stopped automatically and if the temperature is below 900°C an alarm is indicating the operator that the flare is running out of the specified combustion temperature range.

If the temperature decrease significantly from one registration to another (5 minutes interval), it means that the main valve is closed – the flare is stopped and no gas is being burned. It can be confirmed that no gas is being burned by the instant reading of gas flow from the flow-meter FIR200.

However, in some readings it was detected that the flare accepted gas, but with a combustion chamber temperature below 900°C. It happened because between a 5 minutes interval the flare might have stopped and turned on again (i.e. the flare was stopped at 10:01 and tuned on 10:04, not remaining enough time to register a temperature above 900°C). To discount the values below 900°C, the following procedure was applied:

- an hourly average of flares temperature was calculated, considering the temperature registers when the instant gas-flow was above 0 Nm3/h (flares are accepting gas);
- Gas flow (FIR 200) is considered for the CER calculation only in the case when:
  a) Both flares' temperature is above 900°C; or

b) One flare´s temperature is above 900°C and the other flare indicates ambient temperature (until 40° C)

Proper Excel sheets applying the above mentioned procedure were presented to the Verification Team.

Moreover, the flares are equipped with an hour-meter, which measures the accumulated operating hours of the flares. Despite of not being registered by BLFGE's computer supervisory system, Van der Wiel, one of Biogás shareholders, makes the registration of these accumulated operating hours of the flares every 00:01 via a CARS, a system which allows Van der Wiel to have total access to the PLC of BLFGE. This evidence was sent to the Verification Team.

PP has monthly worksheets to calculate the hourly average of flares temperature (as detailed above) and for this monitoring period the worksheets were named "BLFGE – PLC_2010.11" and "BLFGE – PLC 2010.12". These monthly worksheets files are very large because contains data registered by PLC every 5 minutes.

For this reason and in order to maintain transparency and to comply with the reporting requirements, PP decided to include in the CER calculation spreadsheet only the values related to the hourly data of flow and the temperature of the flares. It was created one new worksheet for each month verified, named DATA_NOV_2010 and DATA_DEC_2010 which were included into the CER excel calculation spreadsheet (tool). In order to clarify the process these data were pasted as a link from the monthly worksheets to the CER Calculation spreadsheet.

For the whole monitoring period, the following table presents all measured data and the calculation of methane destroyed.

	MAIN PIPELINE							SECONDARY PIPELINE			ELECTRICITY GENERATION								
	COLLECTING SYSTEM				FLARE F100			FLARE F200			FIR300		FIR400		FIR500		FIR600		
	LFG measured FIR100 (Nm^3)	Methane (%)	*Methane measured FIR100 (Nm^3)*	Flares Efficiencies (%)	LFG measured FIR200 (Nm^3)	*Methane measured FIR200 (Nm^3)*	*Methne Destroyed in F100 (Nm^3)*	LFG measured FIR700 (Nm^3)	*Methane measured FIR700 (Nm^3)*	*Methne Destroyed F200 (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	Eletricity Exported (MWh)
DATE	A	B	*C = A . B*	D	E	*F = E . B*	*G = F . D*	H	*I = H . B*	*J = I . D*	K	*L = K . B*	M	*N = M . B*	O	*P = O . B*	Q	*R = Q . B*	S
01/11/2010	135,856	46.3819	*63,012.5940*	99.9979%	740	*343.2260*	*343.2188*	0	*0.0000*	*0.0000*	20,492	*9,504.5789*	23,913	*11,091.3037*	35,615	*16,518.9136*	54,001	*25,046.6898*	168.61
02/11/2010	136,802	46.6142	*63,769.1578*	99.9979%	610	*284.3466*	*284.3406*	0	*0.0000*	*0.0000*	14,127	*6,585.1880*	22,410	*10,446.2422*	38,647	*18,014.9898*	59,175	*27,583.9528*	168.00
03/11/2010	136,090	46.7916	*63,678.6884*	99.9979%	3,481	*1,628.8155*	*1,628.7816*	0	*0.0000*	*0.0000*	11,811	*5,526.5558*	22,039	*10,312.4007*	51,511	*24,102.8210*	47,149	*22,061.7714*	159.90
04/11/2010	135,640	46.9225	*63,645.6790*	99.9979%	1,753	*822.5514*	*822.5342*	0	*0.0000*	*0.0000*	18,829	*8,835.0375*	22,868	*10,730.2373*	31,708	*14,878.1863*	59,042	*27,703.9824*	164.38
05/11/2010	134,861	47.6836	*64,306.5797*	99.9979%	1,020	*486.3727*	*486.3625*	0	*0.0000*	*0.0000*	21,510	*10,256.7423*	22,896	*10,917.6370*	23,487	*11,199.4471*	65,876	*31,412.0483*	168.38
06/11/2010	140,153	46.3722	*64,992.0294*	99.9979%	192	*89.0346*	*89.0327*	0	*0.0000*	*0.0000*	28,378	*13,159.5029*	24,612	*11,413.1258*	30,164	*13,987.7104*	56,524	*26,211.4223*	175.49
07/11/2010	137,146	45.9718	*63,048.4848*	99.9979%	202	*92.8630*	*92.8610*	0	*0.0000*	*0.0000*	30,236	*13,900.0334*	22,932	*10,542.2531*	32,100	*14,756.9478*	50,685	*23,300.8068*	168.29
08/11/2010	132,530	46.8513	*62,092.0278*	99.9979%	495	*231.9139*	*231.9090*	0	*0.0000*	*0.0000*	30,946	*14,498.6032*	20,993	*9,835.4934*	30,717	*14,391.3138*	47,982	*22,480.1907*	164.42
09/11/2010	131,852	48.0326	*63,331.9437*	99.9979%	1,106	*531.2405*	*531.2294*	0	*0.0000*	*0.0000*	28,392	*13,637.4157*	21,285	*10,223.7389*	31,654	*15,204.2392*	48,657	*23,371.2221*	167.10
10/11/2010	135,732	46.6381	*63,302.8258*	99.9979%	174	*81.1502*	*81.1485*	0	*0.0000*	*0.0000*	30,442	*14,197.5704*	25,060	*11,687.5078*	25,911	*12,084.3980*	52,720	*24,587.6063*	169.25
11/11/2010	132,829	47.2677	*62,785.2132*	99.9979%	0	*0.0000*	*0.0000*	0	*0.0000*	*0.0000*	27,453	*12,976.4016*	25,011	*11,822.1244*	10,839	*5,123.3460*	66,999	*31,668.8863*	162.34
12/11/2010	128,308	47.3218	*60,717.6551*	99.9979%	0	*0.0000*	*0.0000*	0	*0.0000*	*0.0000*	22,274	*10,540.4577*	23,944	*11,330.7317*	13,582	*6,427.2468*	66,937	*31,675.7932*	161.86
13/11/2010	131,469	46.9538	*61,729.6913*	99.9979%	0	*0.0000*	*0.0000*	0	*0.0000*	*0.0000*	38,152	*17,913.8137*	12,211	*5,733.5285*	17,529	*8,230.5316*	62,851	*29,510.9328*	162.88
14/11/2010	127,803	47.5784	*60,806.6225*	99.9979%	150	*71.3676*	*71.3661*	0	*0.0000*	*0.0000*	38,026	*18,092.1623*	12,033	*5,725.1088*	17,196	*8,181.5816*	59,798	*28,450.9316*	161.28
15/11/2010	122,264	47.8527	*58,506.6251*	99.9979%	450	*215.3371*	*215.3326*	0	*0.0000*	*0.0000*	34,285	*16,406.2981*	19,091	*9,135.5589*	30,625	*14,654.8893*	36,767	*17,594.0022*	158.40
16/11/2010	129,420	47.8631	*61,944.4240*	99.9979%	331	*158.4268*	*158.4235*	0	*0.0000*	*0.0000*	27,985	*13,394.4885*	23,733	*11,359.3495*	38,931	*18,633.5834*	35,435	*16,960.2894*	166.02
17/11/2010	129,223	48.1156	*62,176.4217*	99.9979%	1,289	*620.2100*	*620.1970*	0	*0.0000*	*0.0000*	27,931	*13,439.1682*	25,685	*12,358.4918*	42,685	*20,538.1438*	30,210	*14,535.7227*	170.78
18/11/2010	120,573	48.6927	*58,710.2491*	99.9979%	5,012	*2,440.4781*	*2,440.4273*	0	*0.0000*	*0.0000*	22,675	*11,041.0697*	20,762	*10,109.5783*	48,616	*23,672.4430*	17,447	*8,495.4153*	132.72
19/11/2010	127,366	48.2680	*61,477.0208*	99.9979%	2,771	*1,337.5062*	*1,337.4783*	0	*0.0000*	*0.0000*	24,170	*11,666.3756*	22,223	*10,726.5976*	22,435	*10,828.9258*	48,748	*23,529.6846*	160.49

	MAIN PIPELINE							SECONDARY PIPELINE			ELECTRICITY GENERATION								
	COLLECTING SYSTEM				FLARE F100			FLARE F200			FIR300		FIR400		FIR500		FIR600		
DATE	LFG measured FIR100 (Nm³) A	Methane (%) B	*Methane measured FIR100 (Nm³) C = A . B*	Flares Efficiencies (%) D	LFG measured FIR200 (Nm³) E	*Methane measured FIR200 (Nm³) F = E . B*	*Methne Destroyed in F100 (Nm³) G = F . D*	LFG measured FIR700 (Nm³) H	*Methane measured FIR700 (Nm³) I = H . B*	*Methne Destroyed F200 (Nm³) J = I . D*	LFG measured (Nm³) K	*Methane measured (Nm³) L = K . B*	LFG measured (Nm³) M	*Methane measured (Nm³) N = M . B*	LFG measured (Nm³) O	*Methane measured (Nm³) P = O . B*	LFG measured (Nm³) Q	*Methane measured (Nm³) R = Q . B*	Eletricity Exported (MWh) S
20/11/2010	133,814	46.0229	*61,585.0834*	99.9979%	0	*0.0000*	*0.0000*	0	*0.0000*	*0.0000*	24,210	*11,142.1440*	24,571	*11,308.2867*	7,809	*3,593.9282*	74,969	*34,502.9079*	166.86
21/11/2010	132,832	46.2750	*61,468.0080*	99.9979%	991	*458.5852*	*458.5756*	0	*0.0000*	*0.0000*	27,179	*12,577.0822*	24,438	*11,308.6845*	10,614	*4,911.6285*	66,976	*30,993.1440*	165.87
22/11/2010	133,816	46.6170	*62,381.0047*	99.9979%	299	*139.3848*	*139.3819*	0	*0.0000*	*0.0000*	27,734	*12,928.7587*	24,487	*11,415.1047*	15,901	*7,412.5691*	64,772	*30,194.7632*	171.75
23/11/2010	132,982	47.0031	*62,505.6624*	99.9979%	812	*381.6651*	*381.6571*	0	*0.0000*	*0.0000*	26,352	*12,386.2569*	32,852	*15,441.4584*	4,572	*2,148.9817*	64,058	*30,109.2457*	170.44
24/11/2010	127,094	47.5020	*60,372.1918*	99.9979%	1,839	*873.5617*	*873.5435*	0	*0.0000*	*0.0000*	26,408	*12,544.3281*	30,933	*14,693.7936*	16,352	*7,767.5270*	50,539	*24,007.0357*	166.01
25/11/2010	127,399	48.3524	*61,600.4740*	99.9979%	575	*278.0263*	*278.0205*	0	*0.0000*	*0.0000*	27,913	*13,496.6054*	20,495	*9,909.8243*	35,709	*17,266.1585*	41,221	*19,931.3428*	160.33
26/11/2010	130,295	48.3243	*62,964.1466*	99.9979%	475	*229.5404*	*229.5356*	0	*0.0000*	*0.0000*	15,368	*7,426.4784*	25,102	*12,130.3657*	23,150	*11,187.0754*	65,397	*31,602.6424*	169.65
27/11/2010	132,825	47.4697	*63,051.6290*	99.9979%	586	*278.1724*	*278.1666*	0	*0.0000*	*0.0000*	15,703	*7,454.1669*	29,965	*14,224.2956*	37,137	*17,628.8224*	45,920	*21,798.0862*	169.24
28/11/2010	135,751	47.9218	*65,054.3227*	99.9979%	7,476	*3,582.6337*	*3,582.5591*	0	*0.0000*	*0.0000*	21,427	*10,268.2040*	17,352	*8,315.3907*	27,708	*13,278.1723*	56,010	*26,841.0001*	156.05
29/11/2010	132,340	48.4031	*64,056.6625*	99.9979%	976	*472.4142*	*472.4043*	0	*0.0000*	*0.0000*	27,575	*13,347.1548*	24,402	*11,811.3244*	28,333	*13,714.0503*	50,821	*24,598.9394*	170.32
30/11/2010	133,310	46.5513	*62,057.5380*	99.9979%	349	*162.4640*	*162.4606*	0	*0.0000*	*0.0000*	22,060	*10,269.2167*	29,321	*13,649.3066*	14,172	*6,597.2502*	66,779	*31,086.4926*	172.26
01/12/2010	134,530	46.3114	*62,302.7264*	99.9979%	282	*130.5981*	*130.5953*	0	*0.0000*	*0.0000*	33,186	*15,368.9012*	22,026	*10,200.5489*	12,911	*5,979.2648*	65,590	*30,375.6472*	173.34
02/12/2010	132,622	47.0156	*62,353.0290*	99.9979%	2,314	*132.5839*	*132.5811*	0	*0.0000*	*0.0000*	37,530	*17,644.9546*	18,674	*8,779.6931*	9,206	*4,328.2561*	63,104	*29,668.7242*	168.36
03/12/2010	135,039	46.9753	*63,434.9753*	99.9979%	203	*1,087.0084*	*1,086.9857*	0	*0.0000*	*0.0000*	36,700	*17,287.8499*	15,933	*7,484.5745*	33,089	*15,543.6570*	49,110	*23,069.5698*	174.57
04/12/2010	133,595	46.2315	*61,762.9724*	99.9979%	2,799	*93.8499*	*93.8479*	0	*0.0000*	*0.0000*	32,017	*14,801.9393*	18,115	*8,374.8362*	29,399	*13,591.5986*	49,886	*23,063.0460*	168.48
05/12/2010	141,446	46.5371	*65,824.8664*	99.9979%	3,762	*1,302.5734*	*1,302.5463*	0	*0.0000*	*0.0000*	37,564	*17,481.1962*	19,695	*9,165.4818*	26,747	*12,447.2781*	53,491	*24,893.1601*	169.76
06/12/2010	141,992	46.6472	*66,235.2922*	99.9979%	803	*1,754.8676*	*1,754.8310*	0	*0.0000*	*0.0000*	33,163	*15,469.6109*	11,831	*5,518.8302*	29,952	*13,971.7693*	64,138	*29,918.5811*	174.95
07/12/2010	142,597	47.8753	*68,268.7415*	99.9979%	2,374	*384.4386*	*384.4306*	0	*0.0000*	*0.0000*	40,129	*19,211.8791*	11,788	*5,643.5403*	35,621	*17,053.6606*	44,293	*21,205.4066*	169.97
08/12/2010	129,187	49.0708	*63,393.0943*	99.9979%	6,005	*1,164.9407*	*1,164.9164*	0	*0.0000*	*0.0000*	34,741	*17,047.6866*	10,155	*4,983.1397*	32,185	*15,793.4369*	41,308	*20,270.1660*	146.93
09/12/2010	136,610	48.1579	*65,788.5071*	99.9979%	8,325	*2,891.8818*	*2,891.8216*	0	*0.0000*	*0.0000*	41,699	*20,081.3627*	9,482	*4,566.3320*	31,545	*15,191.4095*	42,961	*20,689.1154*	162.39

	MAIN PIPELINE							SECONDARY PIPELINE			ELECTRICITY GENERATION								
	COLLECTING SYSTEM				FLARE F100			FLARE F200			FIR300		FIR400		FIR500		FIR600		
	LFG measured FIR100 (Nm^3)	Methane (%)	*Methane measured FIR100 (Nm^3)*	Flares Efficiencies (%)	LFG measured FIR200 (Nm^3)	*Methane measured FIR200 (Nm^3)*	*Methne Destroyed in F100 (Nm^3)*	LFG measured FIR700 (Nm^3)	*Methane measured FIR700 (Nm^3)*	*Methne Destroyed F200 (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	LFG measured (Nm^3)	*Methane measured (Nm^3)*	Eletricity Exported (MWh)
DATE	A	B	*C = A . B*	D	E	*F = E . B*	*G = F . D*	H	*I = H . B*	*J = I . D*	K	*L = K . B*	M	*N = M . B*	O	*P = O . B*	Q	*R = Q . B*	S
10/12/2010	133,869	48.0065	*64,265.8214*	99.9979%	874	*3,996.5411*	*3,996.4579*	0	*0.0000*	*0.0000*	37,744	*18,119.5733*	12,236	*5,874.0753*	36,979	*17,752.3236*	45,807	*21,990.3374*	170.85
11/12/2010	137,477	48.3961	*66,533.5063*	99.9979%	2,734	*422.9819*	*422.9731*	0	*0.0000*	*0.0000*	30,863	*14,936.4883*	12,656	*6,125.0104*	44,733	*21,649.0274*	44,101	*21,343.1640*	170.08
12/12/2010	138,657	49.0475	*68,007.7920*	99.9979%	2,539	*1,340.9586*	*1,340.9307*	0	*0.0000*	*0.0000*	40,726	*19,975.0848*	10,766	*5,280.4538*	35,592	*17,456.9862*	47,263	*23,181.3199*	172.71
13/12/2010	138,684	48.6881	*67,522.6046*	99.9979%	1,203	*1,236.1908*	*1,236.1650*	0	*0.0000*	*0.0000*	35,899	*17,478.5410*	13,242	*6,447.2782*	37,940	*18,472.2651*	45,607	*22,205.1817*	171.56
14/12/2010	139,701	47.3857	*66,198.2967*	99.9979%	1,938	*570.0499*	*570.0380*	0	*0.0000*	*0.0000*	49,661	*23,532.2124*	11,540	*5,468.3097*	33,896	*16,061.8568*	42,355	*20,070.2132*	172.62
15/12/2010	139,531	47.4524	*66,210.8082*	99.9979%	0	*919.6275*	*919.6083*	0	*0.0000*	*0.0000*	41,615	*19,747.3162*	12,005	*5,696.6606*	34,003	*16,135.2395*	49,648	*23,559.1675*	171.36
16/12/2010	131,421	48.4541	*63,678.8627*	99.9979%	83	*0.0000*	*0.0000*	0	*0.0000*	*0.0000*	38,428	*18,619.9415*	11,936	*5,783.4813*	31,856	*15,435.5380*	48,597	*23,547.2389*	172.20
17/12/2010	131,522	49.5208	*65,130.7465*	99.9979%	217	*41.1022*	*41.1013*	0	*0.0000*	*0.0000*	42,349	*20,971.5635*	9,584	*4,746.0734*	33,836	*16,755.8578*	44,067	*21,822.3309*	172.27
18/12/2010	131,414	48.5437	*63,793.2179*	99.9979%	48	*105.3398*	*105.3376*	0	*0.0000*	*0.0000*	42,173	*20,472.3346*	10,337	*5,017.9622*	25,168	*12,217.4784*	51,470	*24,985.4423*	175.29
19/12/2010	121,755	48.2947	*58,801.2119*	99.9979%	17,040	*23.1814*	*23.1809*	0	*0.0000*	*0.0000*	41,886	*20,228.7180*	13,426	*6,484.0464*	17,423	*8,414.3855*	25,024	*12,085.2657*	136.36
20/12/2010	128,628	49.0430	*63,083.0300*	99.9979%	2,337	*8,356.9272*	*8,356.7533*	0	*0.0000*	*0.0000*	30,601	*15,007.6484*	12,091	*5,929.7891*	31,376	*15,387.7316*	51,669	*25,340.0276*	165.49
21/12/2010	132,458	49.0395	*64,956.7409*	99.9979%	1,839	*1,146.0531*	*1,146.0292*	0	*0.0000*	*0.0000*	31,855	*15,621.5327*	13,933	*6,832.6735*	32,287	*15,833.3833*	51,695	*25,350.9695*	171.25
22/12/2010	136,872	48.1701	*65,931.3792*	99.9979%	663	*885.8481*	*885.8296*	0	*0.0000*	*0.0000*	36,610	*17,635.0736*	17,675	*8,514.0651*	26,692	*12,857.5630*	52,282	*25,184.2916*	178.21

Obs.: the calculation of *methane measured* and *methane destroyed* was conservatively made, using Excel tool “ROUND DOWN” with four decimal rounds.

As mentioned above, if during a certain hour the average flare temperature (F100 or F200) is between 40° and 900°C and the instant gas-flow measured by FIR200 (the flow-meter FIR700 is disconnected to the collecting system) is higher than zero, this gas-flow is excluded from ERs calculation.

The table below presents the electricity exported and registered by Sotreq and the value registered by Eletropaulo, the local electricity utility:

MONTH	ELECTRICITY REGISTERED BY BLFGE (MWh)	ELECTRICITY REGISTERED BY ELETROPAULO (MWh)	DIFFERENCE (%)
November/2010	**4,949.36**	**4,993.49**	**0.88**
December/2010	**3,709.01**	**3,745.63**	**0.98**

Thus, as per presented in the revised Monitoring Plan, the lower values by Sotreq were adopted for the ERs calculation (the one from BLFGE) adopting a conservative approach.

	Total
Total Methane Destroyed in FIR200 (Nm^3)[6]	**44,277.9087**
Total Methane Destroyed in FIR700(Nm^3)	**0.0000**
Total Methane Measured by FIR300 (Nm^3)	**756,105.3536**
Total Methane Measured by FIR400 (Nm^3)	**472,625.7003**
Total Methane Measured by FIR500 (Nm^3)	**695,265.7890**
Total Methane Measured by FIR600 (Nm^3)	**1,275,665.3176**
Total Electricity Exported (MWh)	**8,658.3622**

As mentioned above, follows the description and consideration of measurement uncertainties and error propagation of the equipments. The readings from all equipments are subjected to internal errors from a standard value. These errors are measured and described in the Calibration Certificates, in terms of ± % from the standard adopted.

All calibrations usually have an expiration date, however the manufacturers of the flow-meters, pressure transmitter and temperature transmitters are Europeans and there are no rules in Europe specifying the calibration periodicity. Biogás decided to adopt a 2 years calibration frequency for the electricity meter and 5 years calibration frequency for the others instruments. Regarding electricity meter, the manufacturer does not mention a specific calibration frequency of the meter. Besides, there does not exist any standard or norm in Brazil indicating a specific calibration frequency.

The errors for each equipment will be presented in the formulae [7] below.

Adopting a conservative approach on Emission Reduction calculation, the equivalent error calculated was discounted from the amount of methane calculated for each flow-meter, according with the equations below:

$$\varepsilon_{\text{FIR200}} = \sqrt{\left(\varepsilon_{\text{Gas Flow}_{\text{FIR200}}}\right)^2 + \left(\varepsilon_{\text{Temperature}_{\text{FIR200}}}\right)^2 + \left(\varepsilon_{\text{Pressure}_{\text{FIR200}}}\right)^2 + \left(\varepsilon_{\text{Methane Analysis}}\right)^2}$$

[6] FIR200 referring to the total gas burned on the flares F100 and F200.

[7] All data referring to the FIR700 were excluded because this Flare Auxiliary line was disconnected.

$$\varepsilon_{FIR700} = \sqrt{\left(\varepsilon_{Gas\ Flow_{FIR700}}\right)^2 + \left(\varepsilon_{Temperature_{FIR700}}\right)^2 + \left(\varepsilon_{Pressure_{FIR700}}\right)^2 + \left(\varepsilon_{Methane\ Analysis}\right)^2}$$

$$\varepsilon_{FIR300} = \sqrt{\left(\varepsilon_{Gas\ Flow_{FIR300}}\right)^2 + \left(\varepsilon_{Temperature_{FIR300}}\right)^2 + \left(\varepsilon_{Pressure_{FIR300}}\right)^2 + \left(\varepsilon_{Methane\ Analysis}\right)^2}$$

$$\varepsilon_{FIR400} = \sqrt{\left(\varepsilon_{Gas\ Flow_{FIR400}}\right)^2 + \left(\varepsilon_{Temperature_{FIR400}}\right)^2 + \left(\varepsilon_{Pressure_{FIR400}}\right)^2 + \left(\varepsilon_{Methane\ Analysis}\right)^2}$$

$$\varepsilon_{FIR500} = \sqrt{\left(\varepsilon_{Gas\ Flow_{FIR500}}\right)^2 + \left(\varepsilon_{Temperature_{FIR500}}\right)^2 + \left(\varepsilon_{Pressure_{FIR500}}\right)^2 + \left(\varepsilon_{Methane\ Analysis}\right)^2}$$

$$\varepsilon_{FIR600} = \sqrt{\left(\varepsilon_{Gas\ Flow_{FIR600}}\right)^2 + \left(\varepsilon_{Temperature_{FIR600}}\right)^2 + \left(\varepsilon_{Pressure_{FIR600}}\right)^2 + \left(\varepsilon_{Methane\ Analysis}\right)^2}$$

Calculation of $LFG_{flared,\ y}$

The calculation of $LFG_{flared,\ y}$ is the sum of all measurements from FIR200 and FIR700 made during the monitoring period, minus the uncertainties of the flow-meters, as follows:

$$\varepsilon_{FIR200} = \sqrt{0.8900^2 + 0.6471^2 + 0.0851^2 + 1.000^2} = 1.4894\%$$

$$\varepsilon_{FIR700} = N/A$$

Calculation of $LFG_{electricity,\ y}$

The calculation of $LFG_{electricity,\ y}$ is the sum of all measurements from FIR300, FIR400, FIR500 and FIR600 made during the monitoring period, minus the uncertainties of the flow-meters, as follows:

$$LFG_{electricity,\ y,\ corrected} = \sum FIR_{300} \times \left(1 - \frac{\varepsilon_{FIR300}}{100}\right) + \sum FIR_{400} \times \left(1 - \frac{\varepsilon_{FIR400}}{100}\right) + \sum FIR_{500} \times \left(1 - \frac{\varepsilon_{FIR500}}{100}\right) + \sum FIR_{600} \times \left(1 - \frac{\varepsilon_{FIR600}}{100}\right)$$

Applying the errors from the table below in the equations previously presented:

$$\varepsilon_{FIR300} = \sqrt{0.7720^2 + 0.5993^2 + 0.0567^2 + 1.0000^2} = 1.3995\%$$

$$\varepsilon_{FIR400} = \sqrt{0.5960^2 + 0.1775^2 + 0.0317^2 + 1.0000^2} = 1.1781\%$$

$$\varepsilon_{FIR500} = \sqrt{0.6320^2 + 0.8717^2 + 0.0417^2 + 1.0000^2} = 1.4701\%$$

$$\varepsilon_{FIR600} = \sqrt{0.8110^2 + 0.1998^2 + 0.0417^2 + 1.0000^2} = 1.3037\%$$

Calculation of EGy

The calculation of EG_y is the sum of all measurements from the electricity-meter made during the monitoring period, minus the uncertainties of the electricity-meter, as follows:

$$EG_{y,\,corrected} = \sum EG_y \times \left(1 - \frac{\varepsilon_{EG}}{100}\right)$$

$$\varepsilon_{EG} = 1.0000\%$$

Table providing the formulas used

	Variable	Description
Flare F100	A_{F100} (see last table from item 4.1)	Total methane destroyed in flare F100 (Nm^3)
	B_{F100}	Total error from measuring equipment (%) – see item 4.4
	$C_{F100} = A_{F100} . (1-B_{F100})$	**Total methane corrected destroyed at the flare F100 (Nm^3)**
Flare F200	A_{F200} (see last table from item 4.1)	Total methane destroyed in flare F200 (Nm^3)
	B_{F200}	Total error from measuring equipment (%) – see item 4.4
	$C_{F200} = A_{F200} . (1-B_{F200})$	**Total methane corrected destroyed at the flare F200 (Nm^3)**
Power House	A_{FIRi}[8] (see last table from item 4.1)	Methane flow to the power house measured by FIRi (Nm^3)
	B_{FIRi}	Total measuring error from FIRi (%) – see item 4.5
	$C_{FIRi} = A_{FIRi} . (1 - B_{FIRi})$	**Total methane corrected measured by FIRi (Nm^3)**
	$D_{power\ house} = C_{FIR300} + C_{FIR400} + C_{FIR500} + C_{FIR600}$	**Total methane corrected destroyed at the electricity (Nm^3)**
CO_2e Methane	$A = C_{F100} + C_{F200} + D_{power\ house}$	Total methane destroyed in the period (Nm^3)
	B = 0.0007168	Density of Methane at the STPC (tCH_4/Nm^3)
	C = A . B	Total weight of methane destroyed (tCH_4)
	D = 21	CO_2 equivalency (tCO_2e/tCH_4)
	E = C . D	Total equivalent carbon (tCO_2e)
	F = 20%	Adjustment Factor (%)
	G = E . (1-F)	**Total Liquid Carbon (tCO_2e)**
CO_2e Electricity	H (see last table from item 4.1)	Total electricity exported (MWh)
	I	Electricity-meter error (%)
	J = H . (1 – I)	Total electricity corrected (MWh)
	K = 0.2677	Emission Factor (tCO_2e/MWh)
	L = J . K	**Total CO_2e from the energy exported (tCO_2e)**
TOTAL	**M = G + L**	**TOTAL CREDITS DURING THE PERIOD (tCO_2e)**

Cells in red means that the calculation was made using the Excel tool "DOWN.ROUND" with zero decimal rounds, in order to assure conservativeness.

E.2. Project emissions calculation

Bandeirantes Landfill Gas To Energy Project generates no project emissions since it uses project-generated electricity to operate the landfill gas project, including the pumping equipment for the collection system and energy required to transport heat.

[8] Obs.: calculation made individually for each Flow-Meter (FIR_{300}, FIR_{400}, FIR_{500} and FIR_{600})

E.3. Leakage calculation

No leakages under **ACM0001 – version 02**.

E.4. Emission reductions calculation / table

In accordance with the ACM0001 (version 2) and the registered PDD, emission reductions (ERy, expressed in tCO2) are calculated according to the following formula:

$ER_y = BE_y - PE_y - L_y$

Where:
ER_y = Emission reductions in year $_y$
BE_y = Baseline emissions in year $_y$
PE_y = Project emissions in year $_y$
L_y = Leakage in year $_y$

In BLFGE Project, there are no Project Emissions and leakage. For this reason we considered that:

$ER_y = BE_y$

According to the above calculation of baseline emissions, the project emission reductions are calculated as shown in the table below. The project totally generated 40,816 tCO2e during this monitoring period.

Period	Baseline Emissions	Project Emissions	Leakage	Emission Reductions
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
From 01/11/2010 to 22/12/2010	**40,816**	**-**	**-**	**40,816**

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

The actual emission reductions during the monitoring period are: 40,816 tCO_2.

According to the registered PDD, the estimated value of emission reduction is averagely 921,782 tCO_2e/year, that is 76,815 tCO_2e per month on average and 2,525.43 tCO_2e per day, while the project activity actually generates totally 40,816 tCO2e emission reductions during this monitoring period – from 01/11/2010 to 22/12/2010 – with 52 days when the plants are in operation. That is about 784.92 tCO2e per day, which is 68.92% lower than the estimated average value per day.

Therefore, the emission reductions in this monitoring period are not higher than the estimation in the PDD even when bearing in mind the monitoring period does not cover a full calendar year. The difference between the PDD estimate and the gas flow monitored is mainly due to the landfill´s poor final layer cover, which increases the gas leakage through the landfill´s surface.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**131,322 (value in this monitoring period – 52 days) 921,782 (value in year 2010)**	**40,816**

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

Not applicable.