MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	Bandeirantes Landfill Gas to Energy Project (BLFGE)
Reference number of the project activity	0164
Version number of the monitoring report	Version 01
Completion date of the monitoring report	04/10/2012
Registration date of the project activity	20/02/2006 27/07/2012 (Renewal date)
Monitoring period number and duration of this monitoring period	18th Monitoring Report –From 23/12/2010 to 31/08/2012
Project participant(s)	▪ Prefeitura Municipal de São Paulo – Municipality of São Paulo - Brazil ▪ Biogás Energia Ambiental S.A. - Brazil ▪ KfW Bankengruppe – Germany ▪ Mercuria Energy Trading SA – Switzerland ▪ Fortis Bank N.V/S.A. - Netherlands
Host Party(ies)	Brazil
Sectorial scope(s) and applied methodology(ies)	**Sectorial Scope 13** – Waste Handling and Disposal. Applied Methodology: **ACM 0001 Version 11 -** Consolidated baseline and monitoring methodology for landfill gas project activities.
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	576,357 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	414,037 tCO_2

SECTION A. Description of project activity

A.1. Purpose and general description of 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 12 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.

The Bandeirantes 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 exists 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. The BLFGE Project reduces greenhouse gas emissions.

Bandeirantes Landfill Gas to Energy Project also avoids 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 was started for tests on 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 plants: the degassing station 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 in its plant seven flow meters[1] installed, which are responsible for measuring the volume of gas extracted from the landfill. The power plant has a total of 24 Caterpillar engines, with nominal capacity of 925 kWh installed, resulting in a total capacity of 22.2 MW.

This Monitoring Report refers to the 18th Monitoring Period that contains the period from December 23rd, 2010 until August 31st, 2012. The total emission reductions achieved in this Monitoring Period is given on the table below:

Total tCO_2e from methane destroyed	403,485
Total tCO_2e from electricity dispatched	10,588
Total tCO2e from electricity consumed	36
TOTAL tCO_2e	**414,037**

A.2. Location of project activity

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:

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

S23º25’11.13”
W45º45’21.69”

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil	Biogás Energia Ambiental S.A	No
Brazil	Municipality of São Paulo	No
Switzerland	Mercuria Energy Trading S.A.	No
Netherlands	Fortis Bank N.V/S.A.	No
Germany	KfW Bankengruppe	No

A.4. Reference of applied methodology
The methodology applied to Bandeirantes Landfill Gas to Energy Project is **ACM0001 – version 11**, called “Consolidated baseline and monitoring 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 revised based on **ACM0001 - version 11** of the **“Consolidated baseline and monitoring methodology for landfill gas project activities”**.

A.5. Crediting period of project activity
Bandeirantes Landfill Gas to Energy Project is in the second crediting period that had started on 23/12/2010. This period will finished on 22/12/2017, because the project proponent has chosen a renewable crediting period of 7 years.

SECTION B. Implementation of project activity
B.1. Description of implemented registered project activity
1) 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 station and the power plant.

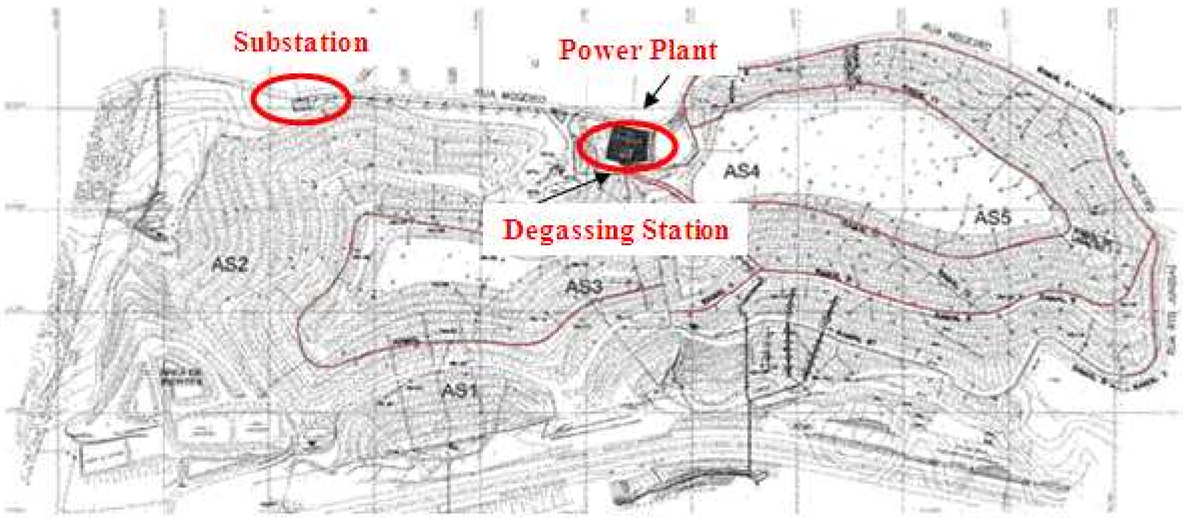


Figure 1- Bandeirantes Landfill Cells

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

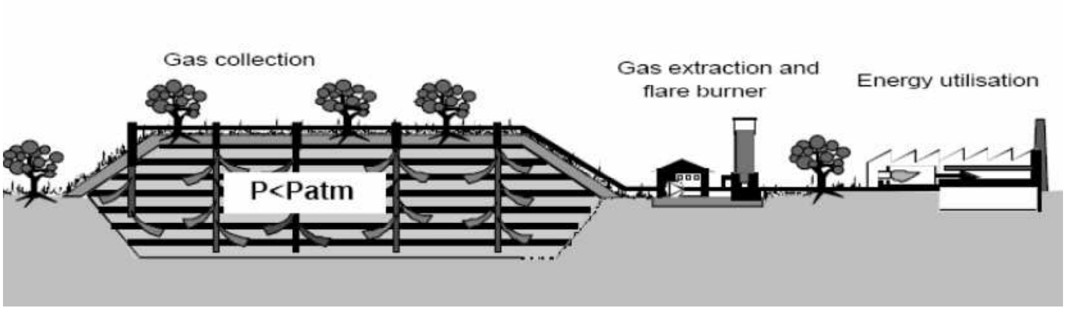


Figure 2 - Bandeirantes degasifying system

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

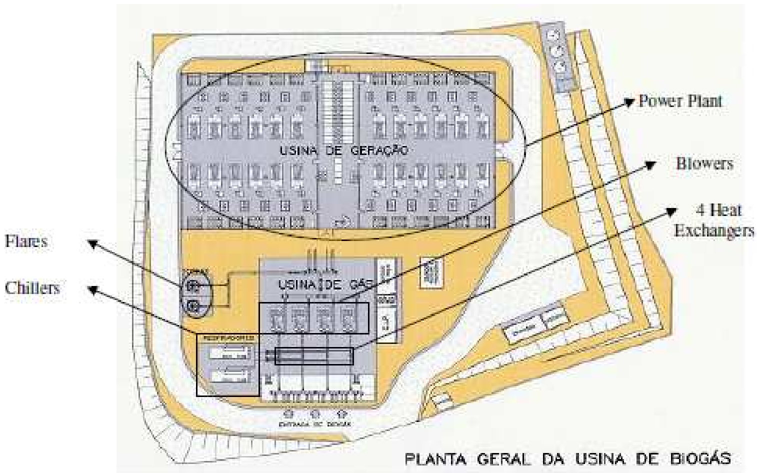
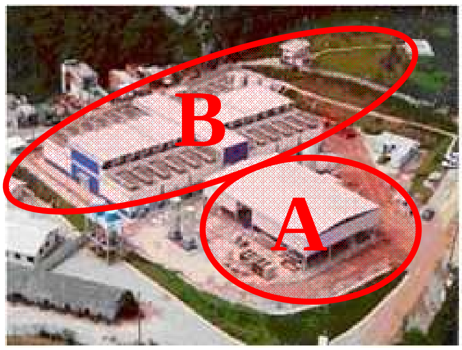


Figure 3– Degassing station and power plant.

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

The degassing station is responsible for extracting the biogas from the landfill and transports 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; measuring and analyzing the quantity and quality of the landfill gas for safety, process and operating purposes.



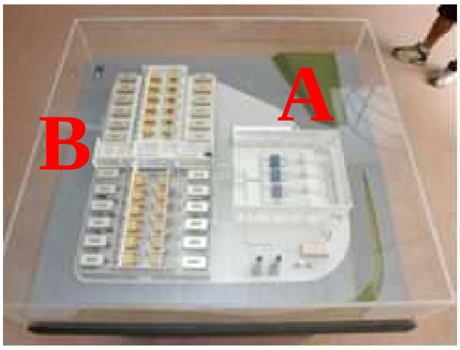


Figure 4 - Degassing Station (A) and Power Plant (B)

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.

The 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 drained off to a condensate shaft as well.

The blowers are used to transport the biogas from the landfill into the gas engines, under correct suction and 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 Itaú - Unibanco's branches over São Paulo state.

There were five special events during this monitoring period.

Event	Description	How the event was considered
01	On April 24th, 2011, the electricity generated was smaller than the normal because AES Eletropaulo had maintenance in their system.	AES Eletropaulo realized maintenance in the transmition line.
		It was observed a small impact related to the produced and exported energy during the period.
02	From March 13rd to March 15th, 2012 the Biogás Energia Ambiental had some problems in the supervisory system (PLC).	The PLC didn't register all the data generated from the degassing plant. However, the PLC from power plant registered the exported energy.
		The event occurred was considered

		punctual by Biogás Energia Ambiental because it had never happened before; The Biogás dismissed these two days of production.
03	On April 16th, 2012, the electricity generated was smaller than the normal because the Biogás Energia Ambiental realized a preventive maintenance in your auxiliary power cab.	Because the maintenance, the biogas production and exported energy were reduced in this day.
		The event occurred was considered punctual by Biogas Energia Ambiental because it had never happened before;
04	From May 19th until May 23rd, 2012 the Biogás Energia Ambiental had some problems (disruption) in its main manifold.	The PP discovered a disruption in the main manifold. The maintenance, in the 5 principal lines, spent 5 days. This long time was spent in order to keep the quality the gas (CH4% and O2%).
		The event occurred was considered punctual by Biogas Energia Ambiental because this kind of maintenance had never happened before;
05	On July 31st, 2012 the electricity generated was smaller than the normal because AES Eletropaulo had some problems in their system.	AES Eletropaulo had some problems in their system and the power plant couldn't export the generated electricity (TRIP Eletropaulo).
		It was observed a small impact related to the exported electricity during the period. This event was not relevant for the degassing plant.

Nowadays about 07 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. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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

B.2.2. Corrections

Not applicable.

B.2.3. Permanent changes from registered monitoring plan or applied methodology
During the First Crediting Period, 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 revalidated PDD had its Monitoring Plan revised based on ACM0001 - version 11 of the "Consolidated baseline and monitoring methodology for landfill gas project activities". The revalidated Monitoring Plan was approved on 27/07/2012.

B.2.4. Changes to project design of registered project activity
Not applicable.

B.2.5. Changes to start date of crediting period
Not applicable.

B.2.6. Types of changes specific to afforestation or reforestation project activity
Not applicable.

SECTION C. Description of monitoring system
The following instruments were installed in the Degassing Station, as per the revised Monitoring Plan:

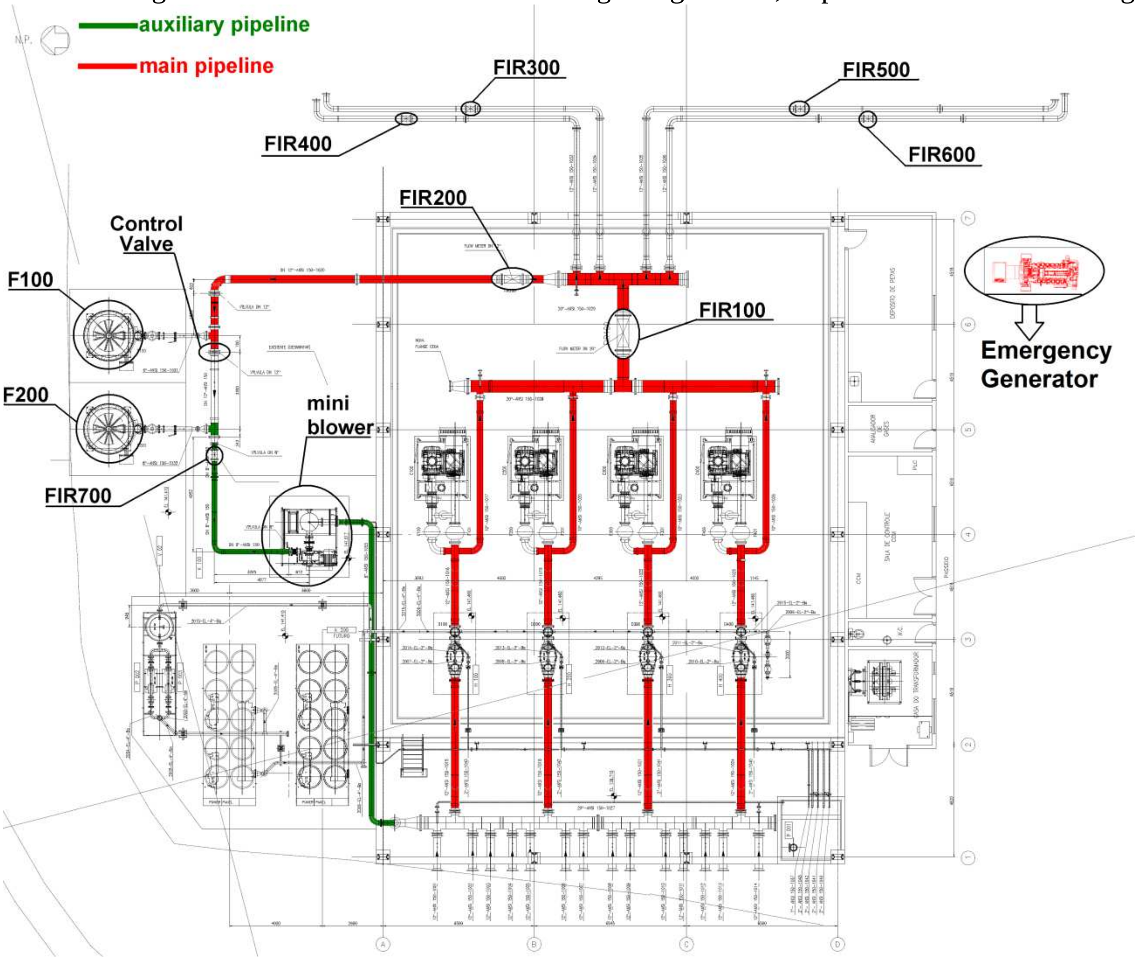


Figure 9 - Lay-out of the Degassing Station

Due to the lack of LFG available at Bandeirantes Landfill, this secondary collection line was deactivated still during the 1st crediting period. In order to comply with the requirements from the methodology,

Biogás Energia Ambiental S.A. will re-activate this secondary line and install the control valve between the 2 flares. Both flares are unlikely to operate at the same time due to the low LFG generation; however during interruption of the power generation the gas will be collected and flared in the two equipments to avoid the increase of pressure inside the landfill
Therefore:

- FIR700 will measure the LFG collected and sent exclusively to the flare F200; and
- FIR200 will measure the LFG collected and sent exclusively to the flare F100.

PDD ID	Data variable	Data Unit	TAG Equipment	Measured (M) Calculated (C) Estimated (E)	Recording frequency	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	FIR100	M	Continuously	E / P	All registration will be kept for 2 years after the end of the crediting period	Measured by a two flow meters. Data will be aggregated monthly and yearly.
2 - $LFG_{Flare, y}$	Total amount of landfill gas flared	Nm^3	FIR200 FIR700	M	Continuously	E / P	All registration will be kept for 2 years after the end of the crediting period	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 and the second one located in a dedicated line connected to a mini-blower.
3 - $LFG_{Electricity, y}$	Total amount of landfill gas combusted in power plant	Nm^3	FIR300 FIR400 FIR500 FIR600	M	Continuously	E / P	All registration will be kept for 2 years after the end of the crediting period	Measured by 4 flow meters. Data will be aggregated daily, monthly and yearly.
4 – T_{Flares}	Temperature in the exhaust gas of the flare	ºC	TAC 520 (F100) TAC 570 (F200)	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period	Continuous readings from the thermocouples installed in each flare. The instruments are connected to a supervisory computer system, which registers continuously the combustion temperature measured. For each flare, the supervisory system makes records of instant temperature every 5 minutes and every hour

PDD ID	Data variable	Data Unit	TAG Equipment	Measured (M) Calculated (C) Estimated (E)	Recording frequency	Data achievement: Electronic (E) Paper (P)	For how long is archived data kept?	Comment
5 - w_{CH4}	Methane fraction in the landfill gas	%	A100	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period	Measured by continuous gas quality analyzer.
6	Regulatory requirements relating to landfill gas projects	Test	N/A	N/A	Annually	E	All registration will be kept for 2 years after the end of the crediting period	Required for any changes to the adjustment factor (AF) or directly $MD_{reg,y}$
7 – $EL_{LFG,y}$[2]	Net amount of electricity generated using LFG	MWh	N/A	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period	Continuous readings from the electricity-meters located in the substation connected to the SIN. The substation has 2 measurement points: one belongs to Biogeração (manager of the power plant) and the other belongs to Eletropaulo (Electric Utility). Each set of meter is connected to the responsible supervisory system, which registers continuously the electricity exported.
8 - EF[2]	Electricity Baseline Emission Factor	tCO_2/MWh	C	C[3]	At baseline renewal	E	During the crediting period and two years	This data will be updated at the baseline renewal, in accordance with the considered methodology.

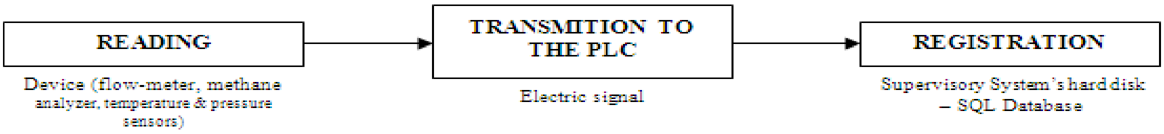
[2] Monitoring parameters as per methodology ACM0001 – version 11 – Tool to calculate Project or Leakage CO2 emissions from fossil fuel.
[3] This variable was calculated according with the ex-post monitoring of EF_{OM} and EF_{BM} by the CIMGC.

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 Supervisory System hard disk as presented in the figure below:



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				
$LFG_{Electricity,\ y}$	FIR300 FIR400 FIR500 FIR600				

Methodology ID	Equipment TAG	Reading Frequency	Transmition Frequency	Registration Frequency	Comments
T_{Flare}	TAC520 and TAC570	Continuously	Continuously	Every 5 minutes	- Temperatures below 900oC 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 BLFGE_18th_Verification_Calculation SpreadsheetV01) - The methane analysis in the exhaust gas is made according with internal procedures from the hired company
$w_{CH4,\ y}$	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)
$EL_{LFG,\ y}$	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)

Involvement of third parties:

BFLGE has one third part involved:

- 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.

Quality assurance and quality control measures:

Internal Procedures 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 Coordinator of Biogás Energia Ambiental S.A., 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.

Organizational Structure, responsibilities and competencies:

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

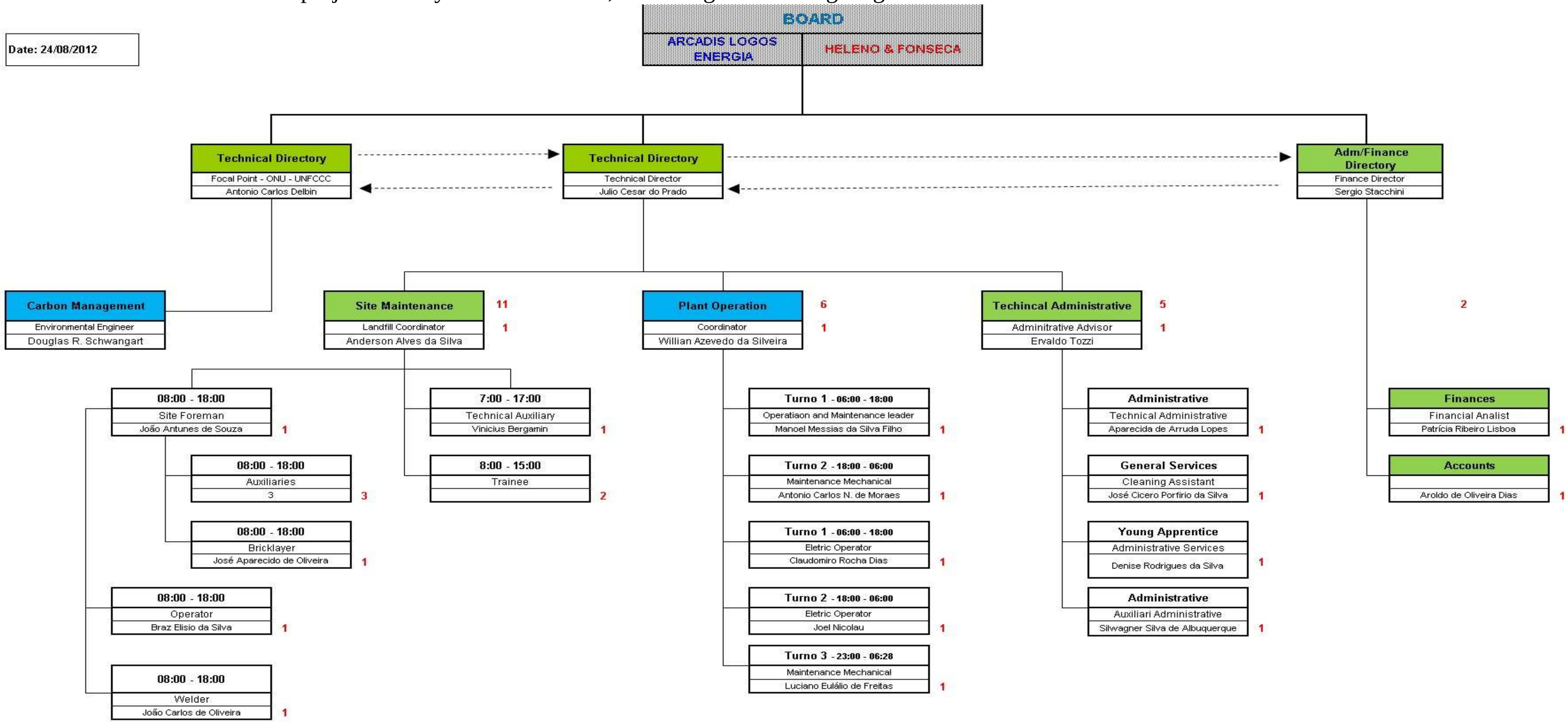


Figure 11 - General Organogram of Biogás

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 figure below:

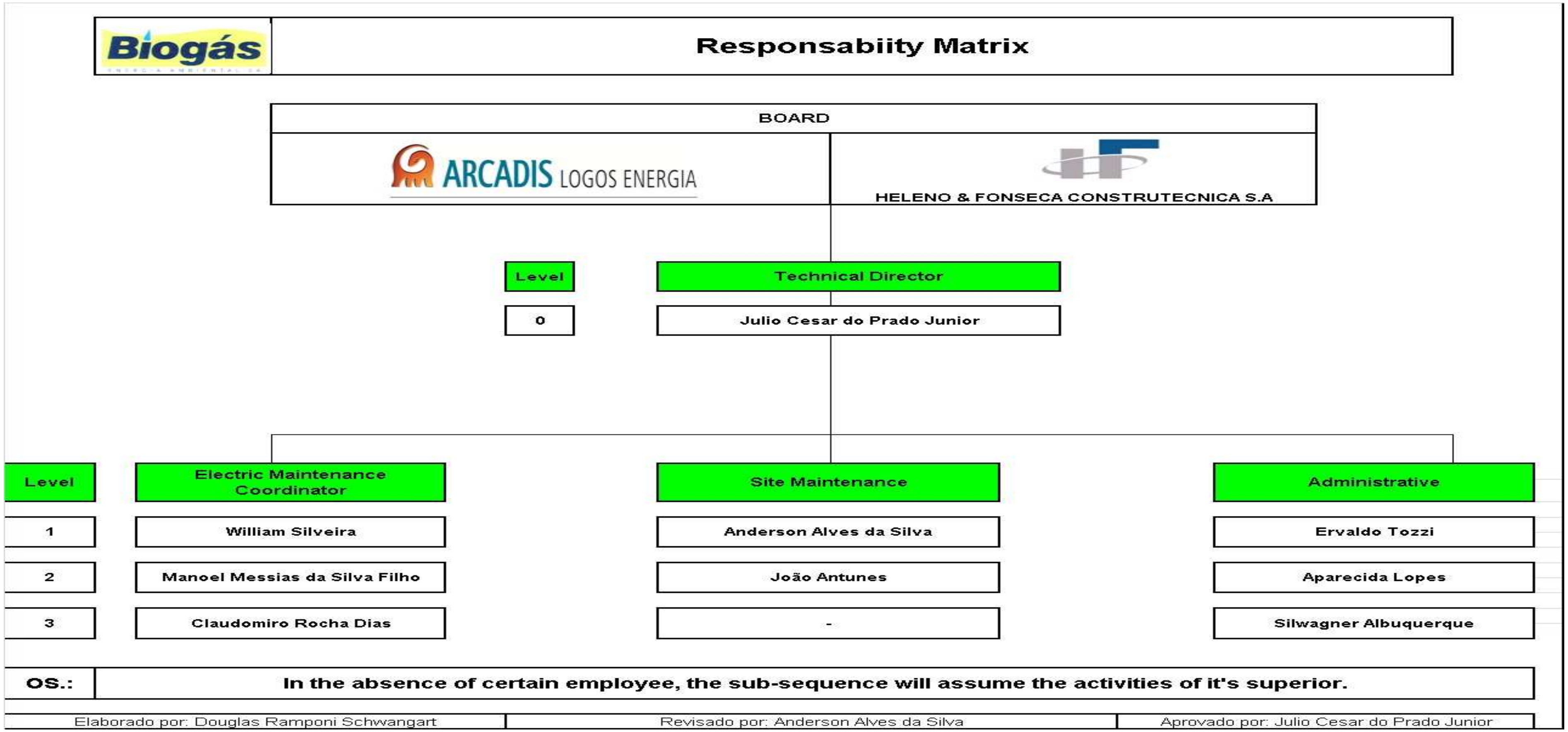


Figure 12 - Responsibility Matrix of Biogás Energia Ambiental

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: Antonio Carlos Nascimento de Moraes to work as Maintenance Mechanical and Luciano Eulálio de Freitas to work as Maintenance Mechanical.

The new operators realized the training in the following periods: 02/04/2012 to 12/04/2012 and 01/05/2012 to 11/05/2012.

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 ARCADIS Logos (one of Biogás Energia Ambiental S.A. shareholders);

SECTION D. Data and parameters
D.1. Data and parameters fixed *ex-ante* or at renewal of crediting period –

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential value for methane
Source of data used:	IPCC
Value(s) :	21
Purpose of data:	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**D_{CH4}**
Data unit:	tCH_4/m^3CH_4
Description:	Methane Density
Source of data used:	-
Value(s) :	0.0007168
Purpose of data:	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**EF_{OM}**
Data unit:	tCO2e/MWh
Description:	CO_2 emission intensity of the electricity
Source of data used:	Brazilian Grid - CIMGC
Value(s) :	0.2476
Description measurement methods and procedures to be applied:	This variable will be monitored *ex-post* by the CIMGC and will be updated monthly in their web-site.
Purpose of data:	Baseline calculation
QA/QC:	The CIMGC calculates the annual value of EF_{OM} , based on

	information from the national electric sector.

Data / Parameter:	**EF_{BM}**
Data unit:	tCO2e/MWh
Description:	Emission Factor of the Built Margin of 2009
Source of data used:	Brazilian Grid - CIMGC
Value(s) :	0.0794
Description measurement methods and procedures to be applied:	This variable will be monitored *ex-post* by the CIMGC and will be updated monthly in their web-site.
Purpose of data:	Baseline calculation
QA/QC:	The CIMGC calculates the annual value of EF_{BM}, based on information from the national electric sector.

Data / Parameter:	**AF**
Data unit:	%
Description:	Adjustment Factor
Source of data used:	PDD Registered
Value(s) :	20
Purpose of data:	Baseline calculation
Additional comment:	N/A

D.2. Data and parameters monitored

Data / Parameter:	**$LFG_{Total, y}$**
Data unit:	Nm^3
Description:	Total amount of landfill gas captured 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 "BLFGE_18th_Verification_Calculation SpreadsheetV01"
Monitoring equipment:	(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 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

Monitoring equipment:

Equipment	TAG	Manufacturer	Model	Serial Number	Error (%)	Date of the last calibration	Date of the next calibration
1) Flow-meter	FIR 100	Endress + Hauser	t-mass 65 I DN175 / 7" (177.75 mm)	9407D902000	0.06	25/04/2007	25/04/2012
2) Flow-meter	FIR 100	FCI	ST51-1F33FM00	341992	0,34	29/04/2011	29/04/2016

	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.
Purpose of data	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.
Additional comment	1) This flow meter was in operation from 23/12/2010 to 15/08/2011. 2) This flow meter is in operation since 16/08/2011.

Data / Parameter:	**$LFG_{Flare, y}$**
Data unit:	Nm^3
Description:	Amount of landfill gas to flares 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 "BLFGE_18th_Verification_Calculation SpreadsheetV01"
Monitoring equipment:	(see table below)

Equipment	**TAG**	**Manufacturer**	**Model**	**Serial Number**	**Error (%)**	**Date of the last calibration**	**Date of the next calibration**
Turbine Flow-meters	FIR200	Incontrol	VTGE X-200	VG15239	0.89	01/07/09	01/07/14
Flow-meter	FIR700	FCI	ST51	328849	0,26	08/09/10	08/09/15
Pressure Transmitter	FIR200	SMAR	LD291	L454793/ L42236	0.0851	27/03/09	27/03/14
	FIR700[4]	N/A	N/A	N/A	N/A	N/A	N/A
Temperature Transmitter	FIR200	ASTA	PT-100	S377815	0.6471	26/03/09	26/03/14
	FIR700	N/A	N/A	N/A	N/A	N/A	N/A

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 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.
Purpose of data	Baseline emission calculation
Additional comment	

[4] The FIR700 has an integrated system which calculates pressure and temperature in real time. In this way this instrument doesn't need Pressure and Temperature Transmitter.

Data / Parameter:	**$LFG_{Electricity, y}$**
Data unit:	Nm^3
Description:	Amount of landfill gas to powerhouse from the landfill site in normal cubic meters at standard temperature and pressure
Measured /Calculated /Default:	Measured by four flow meters
Source of data:	PLC data records
Value(s) of monitored parameter:	These values are indicated in "BLFGE_18th_Verification_Calculation SpreadsheetV01"
Monitoring equipment:	

Equipment	TAG	Manufacturer	Model	Serial Number	Error (%)	Date of the last calibration	Date of the next calibration
Turbine Flow-meters	FIR300	Incontrol	VTG EX-200	VG083B6	0.772	12/12/06	12/12/2011
	FIR400			VG084B6	0,596		
	FIR500			VG086B6	0.632		
	FIR600			VG085B6	0,811		
Turbine Flow-meters	FIR300	Incontrol	VTG EX-200	VG083B6	0,56	03/11/2011	03/11/2016
	FIR400			VG084B6	0,87	10/03/2011	10/03/2016
	FIR500			VG086B6	0,43	14/12/2011	14/12/2016
	FIR600			VG085B6	0,21	14/09/2011	15/09/2016
Pressure Transmitter	FIR300	SMAR	LD291	33007-06	0.0567	06/05/09	06/05/14
	FIR400			L454794/ L42237	0.0317	27/03/09	27/03/14
	FIR500			33006-06	0.0417	23/06/09	23/06/14
	FIR600			33005-06	0.0417	17/04/09	17/04/14
Temperature Transmitter	FIR300	ASTA	PT-100	S502986	0.5993	26/03/09	26/03/14
	FIR400			S502987	0.1775		
	FIR500			S502988	0.8717		
	FIR600			S502989	0.1998		

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 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.
Purpose of data	Baseline emission calculation
Additional comment	These flow meters (FIR300, FIR400, FIR500, FIR600) were removed to calibration and were installed. The dates of installation after calibration are described in the worksheet "BLFGE_18th_Verification_Calculation SpreadsheetV01" attached in the MR.

Data / Parameter:	**T_{Flare}**
Data unit:	°C

<table>
<tr><td>Description:</td><td>Temperature of the exhaust gas in the flare F100 and F200</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>-</td></tr>
<tr><td>Monitoring equipment:</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>Thermocouple F100</td><td>TAC520</td><td>Jumo</td><td>type "S" L750</td><td>32950/030</td><td>N/A</td><td>24/08/2011</td><td>24/08/2012</td></tr>
<tr><td>Thermocouple F200</td><td>TAC570</td><td>Jumo</td><td>type "S" L750</td><td>32411/030</td><td>N/A</td><td>19/09/2011</td><td>19/09/2012</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>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.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>N/A</td></tr>
<tr><td>QA/QC procedures applied:</td><td>Thermocouples will be replaced or calibrated every year.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comment</td><td>A value of 90% flare efficiency was applied for the purpose of ERs estimations, according to the “Tool to determine project emissions from flaring gases containing methane”.</td></tr>
</table>

Data / Parameter:	$W_{CH4,y}$
Data unit:	$m^3 CH_4/m^3 LFG$
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 “BLFGE_18th_Verification_Calculation SpreadsheetV01”
Monitoring equipment:	Manufacturer: Rosemount - NUK Type: Binos 100 TAG: A100 Accuracy class: 1.0000% (error) Serial number: 99965398 Calibration frequency: weekly, with a standard gas Date of last calibration which affected this Monitoring Period: 30/08/2012. Validity: Each calibration is valid for one week.
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	The gas analyzer is 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.
Purpose of data	Baseline emission calculation
Additional comment	N/A

Data / Parameter:	**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 Solutions”
Value(s) of monitored parameter:	Required for any changes to the adjustment factor (AF) or directly MDreg,y
Monitoring equipment:	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 $MD_{reg,y}$
Purpose of data	Baseline emission calculation
Additional comment	N/A

Data / Parameter:	**$EL_{LFG,y}$**
Data unit:	**MWh**
Description:	Net amount of electricity generated using LFG.
Measured /Calculated /Default:	Measured
Source of data:	PLC data records
Value(s) of monitored parameter:	See section “BLFGE_18th_Verification_Calculation SpreadsheetV01”.
Monitoring equipment:	Manufacturer: Merlin Gerin Type: Power Logic – CM4000 TAG: Not applicable Accuracy class: 1.0000% (error) Serial number: 0011001414 Calibration frequency: 2 years 1)Date of last calibration: 30/10/2009 Validity: 30/10/2011[5] 2)Date of last calibration: 16/04/2012 Validity: 15/04/2014[5]
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

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

	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.[6]
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.
Purpose of data	Baseline emission calculation
Additional comment	N/A

D.3. Implementation of sampling plan
Not applicable.

SECTION E. Calculation of emission reductions or GHG removals by sinks
E.1. Calculation of baseline emissions or baseline net GHG removals by sinks
According with baseline methodology ACM0001 – version 11, Emission Reductions are calculated as follows:

$$BE_{y} = \left(MD_{project,\ y} - MD_{BL,\ y}\right) \times GWP_{CH4} + EL_{LFG,\ y} \times CEF_{elec,\ BL,\ y} + ET_{LFG,\ y} \times CEF_{ther,\ BL,\ y} \quad (1)$$

In the case where the $MD_{BL,y}$ is given/defined in the regulation and/or contract as a quantity that quantity will be used. In situations where in the baseline LFG captured and destroyed, for reasons other than regulation and/or contract, historic data on actual amount captured shall be used as $MD_{BL,y}$.

In cases where regulatory or contractual requirements do not specify $MD_{BL,y}$ or no historic data exists for LFG captured and destroyed an "Adjustment Factor" (AF) shall be used and justified, taking into account the project context.

$$MD_{BL,y} = MD_{project,y} \times AF \quad (2)$$

Where AF is the baseline adjustment factor.

In order to be conservative, the AF of 20% applied for the 1st crediting period[7] will remain the same and equation (1) is updated to:

$$BE_{y} = 0{,}8 \times MD_{project,y} \times GWP_{CH4} + EL_{LFG,y} \times CEF_{elec,BL,y} + ET_{LFG,y} \times CEF_{ther,BL,\ y} \quad (3)$$

In this way, the $\boldsymbol{MD_{project,\ y}}$ is calculated as the sum of methane flow destroyed in the flares, in the power house and in the heat generation, as follows:

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[6] AES Eletropaulo data are compared with SOTREQ electricity data and the lower value, namely SOTREQ data is used in the ER calculation.
[7] The value calculated to the Adjustment Factor for the 2nd Credit Period is equal to 19.11%. In this way and to be conservative, the PP applied the AF value of 20% applied during the 1st Crediting period.

$$MD_{project,\ y} = MD_{flared,\ y} + MD_{electricity,\ y} + MD_{thermal,\ y} + MD_{PL,\ y} \quad (4)$$

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);
$MD_{PL,y}$ = Quantity of methane sent to the gas distribution grid (tCH_4)

As the BLFGE Project does not use the methane to generate thermal energy, $MD_{thermal,\ y} = 0$ and $MD_{PL,y} = 0$. As the project has 2 lines installed at the degassing station, equation (2) is updated to:

$$MD_{project,\ y} = MD_{main\ line,y} + MD_{secundary\ line,y} \quad (5)$$

Where:

$MD_{main\ line,y}$ = Quantity of methane destroyed in the main line (tCH4);
$MD_{secondary\ line,y}$ = Quantity of methane destroyed in the secondary line (tCH4);

In this way, the **$MD_{main\ line,\ y}$** is calculated as the sum of the amount of LFG destroyed in the flare F100 (measured by the flow-meter FIR200) and the sum of the amount of LFG destroyed in the power plant (measured by the flow-meters FIR300, FIR400, FIR500 and FIR600), as follows:

$$MD_{main\ line,\ y} = MD_{flare\ F100,y} + MD_{electricity,y} \quad (6)$$

Where:

$MD_{flareF100,y}$ = Quantity of methane destroyed in the flare F100 (tCH4);
$MD_{electricity,y}$ = Quantity of methane destroyed in the power plant (tCH4)

Thus, the **$MD_{secondary\ line,\ y}$** is calculated as the amount of LFG destroyed in the flare F200 (measured by the flow-meter FIR700):

$$MD_{secondary\ line,\ y} = MD_{flare\ F200,y} \quad (7)$$

Where:

$MD_{flareF200,y}$ = Quantity of methane destroyed in the flare F200 (tCH4);
$MD_{flared,\ y}$ is calculated as follows:

$$MD_{flared,\ y} = (LFG_{flared,\ y} \times w_{CH4} \times D_{CH4}) - (PE_{flare,\ y}/GWP_{CH4}) \quad (8)$$

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 ($m^3_{CH4}/m^3 LFG$)

$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in flare F200 in year y (tCO_2e) determined following the procedure described in the *Version 01 of the Tool to determine project emissions from flaring gases containing methane*.
D_{CH4} = Methane density expressed in tones of methane per cubic meter of methane (tCH_4/m^3_{CH4});

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

$$MD_{electricity,\ y} = LFG_{electricity,\ y} \times w_{CH4} \times D_{CH4} \qquad (9)$$

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 tones of methane per cubic meter of methane (tCH_4/m^3_{CH4});

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

$$MD_{project,\ y} = \left(MD_{flare\ F100,\ y} + MD_{Electricity,y}\right) + \left(MD_{flare\ F200,\ y}\right) \qquad (10)$$

According to the mentioned above, the ***Emission reductions*** are calculated as follows***:***

$$ER_y = BE_y - PE_y$$

Where:

ER_y = Emission reduction in year y (tCO_2e);
BE_y = Baseline Emissions due to the natural emissions of methane to the atmosphere and due to the displacement of grid-fossil fuel electricity generation in year y, discounting the emissions due to flare inefficiency (tCO2e) ;
PE_y = Project Emission from electricity consumption from the grid and from the captive diesel generator in year y (tCO_2e)

$$PE_y = PE_{EC,y} = PE_{EC,\ Scenario\ B,y}$$

Where:

$PE_{EC,y}$ = Project Emissions from Electricity consumption in year *y* (tCO_2/yr);
$PE_{EC,\ ScenarioB,y}$= Project Emissions from Electricity consumption in Scenario B in year *y* (tCO_2/yr).

$$PE_{EC,\ Scenario\ B,y} = EC_{PJ,\ ECDG,\ y} \times EF_{EL,\ ECDG,\ y} \times (1 + TDL_{j,y})$$

Where:

$EC_{PJ,\ ECDG,y}$ = Quantity of electricity consumed by the emergency diesel generator in year *y* (MWh/yr);
$FE_{EL,ECDG,y}$ = Emission Factor for the emergence captive diesel generator in the year *y* (tCO_2/MWh);
$TDL_{ECDG,y}$ = Average technical transmition and distribution loses for providing electricity by the emergency diesel generator in year *y*.

In this Project $TDL_{ECDG,y}$ is equal 0 (zero), as there are no loses in the electricity transmition once the diesel generator is located inside BLFGE.

Flare Efficiency:

The project will apply the default value of 90% Flare Efficiency, through monitoring of the flare temperature and other parameters, according to the "Tool to determine project emissions from flaring gases containing methane".

The monitoring 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.

According with the manufacturer, if the temperature of the flare is higher than 1,350^{o}C, the flare will be stopped automatically and if the temperature is below 900^{o}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-meters FIR200 and FIR700.

However, in some readings it was detected that the flare accepted gas, but with a combustion chamber temperature below 900^{o}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^{o}C). To discount the values below 900^{o}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 Nm^3/h (flares are accepting gas);
- Gas flow (FIR 200 and FIR 700) is considered for the CER calculation only in the case when:

a) Both flares' temperature is above 900°C; or

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

Proper Excel sheets applying the above mentioned procedure are 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 is 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 2010.12", "BLFGE – PLC 2011.01", "BLFGE – PLC 2011.02", "BLFGE – PLC 2011.03", "BLFGE – PLC 2011.04", "BLFGE – PLC 2011.05", "BLFGE – PLC 2011.06", "BLFGE – PLC 2011.07" , "BLFGE – PLC 2011.08" "BLFGE – PLC 2011.09", "BLFGE – PLC 2011.10", "BLFGE – PLC 2011.11", "BLFGE – PLC 2011.12", "BLFGE – PLC 2012.01", "BLFGE – PLC 2012.02", "BLFGE – PLC 2012.03", "BLFGE – PLC 2012.04", "BLFGE – PLC 2012.05", "BLFGE – PLC 2012.06", "BLFGE – PLC 2012.07" and "BLFGE – PLC 2012.08". 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_DEC_2010, DATA_JAN_2011, DATA_FEB_2011, DATA_MAR_2011, DATA_APR_2011, DATA_MAY_2011, DATA_JUN_2011, DATA_JUL_2011, DATA_AUG_2011, DATA_SEP_2011, DATA_OCT_2011, DATA_NOV_2011, DATA_DEZ_2011, DATA_JAN_2012, DATA_FEB_2012, DATA_MAR_2012, DATA_APR_2012, DATA_MAY_2012, DATA_JUN_2012, DATA_JUL_2012 and DATA_AUG_2012. 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.

It was created a Spreadsheet called "BLFGE_18th_Verification_Calculation SpreadsheetV01, which contains all the values mentioned above. This spreadsheet will be attached to Monitoring Report.

A consolidation of methane destroyed and electricity consumed/exported is presented in the table below:

Total Methane Destroyed in Flares (Nm^3), measured by FIR200 and FIR700	**493,652**
Total Methane destroyed in the Power House (Nm^3), measured by FIR300, FIR400, FIR500 and FIR600	**33,012,526**
Total Electricity Consumed from the diesel generator (MWh)	**26.2500**
Total Electricity Exported, measured at Bandeirantes Landfill's substation (MWh)	**88,393.7070**

As mentioned on item **D.2 Data and parameters monitored**, 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 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:

$$\varepsilon_{FIR200} = \sqrt{\left(\varepsilon_{Gas\,Flow_{FIR200}}\right)^2 + \left(\varepsilon_{Temperature_{FIR200}}\right)^2 + \left(\varepsilon_{Pressure_{FIR200}}\right)^2 + \left(\varepsilon_{Methane\,Analysis}\right)^2}$$

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

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

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

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

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

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:

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

$$\varepsilon_{FIR700} = \sqrt{0.0260^2 + 1.000^2} = 1.0333\ \%$$

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:

First Monitoring Period before calibration of the flow meters:

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

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

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

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

Second Monitoring Period before calibration of the flow meters:

$$\varepsilon_{FIR300} = \sqrt{0.5600^2 + 0.5993^2 + 0.0567^2 + 1.0000^2} = 1.2946\%$$

$$\varepsilon_{FIR400} = \sqrt{0.8700^2 + 0.1775^2 + 0.0317^2 + 1.0000^2} = 1.3377\%$$

$$\varepsilon_{FIR500} = \sqrt{0.4300^2 + 0.8717^2 + 0.0417^2 + 1.0000^2} = 1.3952\%$$

$$\varepsilon_{FIR600} = \sqrt{0.2100^2 + 0.1998^2 + 0.0417^2 + 1.0000^2} = 1.0420\%$$

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:

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

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

E.2. Calculation of project emissions or actual net GHG removals by sinks

Bandeirantes Landfill Gas to Energy Project has project emissions from the consumption of electricity regarding an emergency diesel generator during energy supply black-outs, as per stated in the revalidated monitoring plan. This emission will only be accounted during emergency situations and the electricity consumed by BLFGE will be from the Power Plant. Project emissions from the diesel generator are discounted of the total CERs generated.

E.3. Calculation of leakage

No leakages under **ACM0001 – version 11**.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

In accordance with the ACM0001 (version 11) and the revalidated PDD, emission reductions (ERy, expressed in tCO2) are calculated according to the following formula:

$$\mathbf{ER_y = BE_y - PE_y}$$

Where:

ER_y = Emission reductions in year $_y$
BE_y = Baseline emissions in year $_y$
PE_y = Project emissions in year $_y$

According to the mentioned above, calculation of baseline emissions, the project emission reductions are calculated as shown in the table below. The project totally generated 406,861 tCO2e during this monitoring period.

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
23/12/2010 to 31/08/2012	414,073	36	-	414,037

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

The actual emission reductions during the monitoring period are: 414,037 tCO_2.

According to the registered PDD, the estimated value of emission reduction is averagely 250,268 tCO_2e/year, that is 20,856 tCO_2e per month on average and 685.67 tCO_2e per day, while the project activity actually generates totally 414,037 tCO2e emission reductions during this monitoring period – from

23/12/2010 to 31/08/2012 – with 618 days when the plants are in operation. That is about 669.96 tCO2e per day, which is 2.29% 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 estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	2010 - 9,534 2011 – 361,517 2012 – 205,307 (from January to August)	414,037

E.6. Remarks on difference from estimated value in registered PDD
Not Applicable.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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