Monitoring report form (Version 03.2)

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 07
Completion date of the monitoring report	11/12/2013
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 – 1st Monitoring period of the second crediting period.
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
Sectoral scope(s) and applied methodology(ies)	**Sectorial Scope 13** – Waste Handling and Disposal. **Sectoral Scope 1** - Energy industries (renewable-/non-renewable sources) 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	576,358 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	413,233 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	413,233 tCO_2
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	N/A

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[1], two chillers and one emergency diesel generator, that after its commissioning on December 21st 2010,started its operation on January 1st 2011. The degassing station has in its plant seven flow meters[2] 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	395,976
Total tCO_2e from electricity dispatched	17,295
Total tCO2e from the diesel generator	38
TOTAL tCO_2e	**413,233**

[1] "High temperature flare HOFGAS – Efficiency 2500" (manufactured by Hofstetter) installed at the site with the following Characteristics: Dimensions (height: 8.126m, diameter: 2.069m), gas flow capacity (Min: 500Nm3/h, Max: 2,500 Nm3/h), combustion temperature (1,000ºC – 1200ºC).

[2] 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).

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:

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"**.
Version 01 of the Tool to determine project emissions from flaring gases containing methane, is applied.
Version 02.2.1 of the Tool for calculation of emission factor for electricity systems.
Version 01 of the Tool to calculate baseline, project and/or leakage emissions from electricity consumption.

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 finish 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..Three main units can be detached: the substation, the degassing station and the power plant.

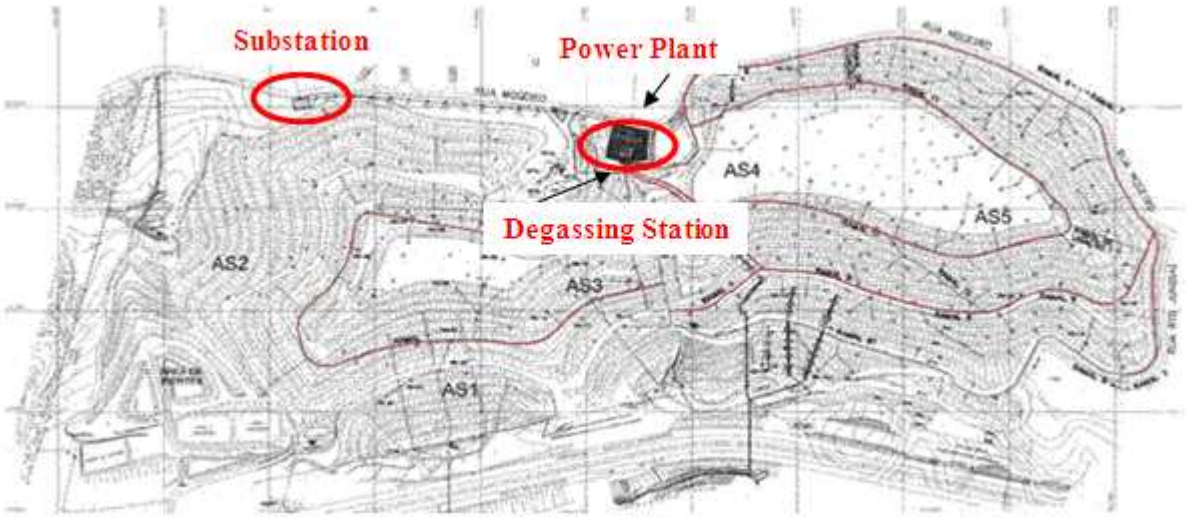


Figure 1- Bandeirantes Landfill Cells

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

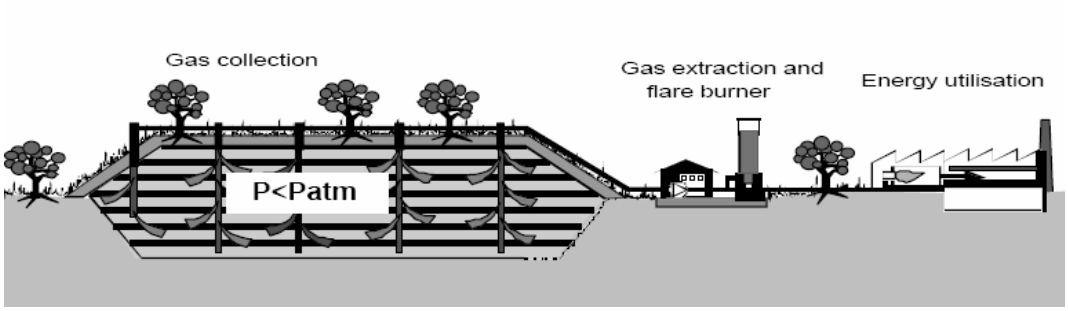


Figure 2 - Bandeirantes degasifying system

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

Figure 3– Degassing station (A) and power plant (B).

From figure above, two main units can be detached: the degassing station (A) and the power plant (B).

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.

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 4ºC 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 4 - 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. One emergency diesel generator was installed to provide energy in case of electricity outage.

Figure 5 - Turbine Flow-meter and diesel generator.

Figure 6 - Generators used to produce electricity

Figure 7 - Flare used to destroy the surplus gas collected

For electricity generation, a total of 24 Caterpillar engines, nominal capacity of 925 kW, model 3516A 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 six special events during this monitoring period.

Event	Description	How the event was considered
01	On April 24th, 2011, the electricity generated and LFG measured were smaller than the normal because AES Eletropaulo had maintenance in their system.	AES Eletropaulo realized maintenance in the transmission line.
		It was observed a small impact related to the LFG measured and exported energy during the period.
02	On February 23rd, 2012, there was a problem with the computer that registers the PLC data. The screen of the computer crashed and the record data between 08:00am and 02:45pm wasn't saved.	Biogás calls Iastech [3] to solve the problem.
		The event occurred was considered punctual by Biogás Energia Ambiental because it had never happened before; This event didn't impacted neither the biogas production nor the electricity generated, because the recorded data accumulated are not impacted.
03	From March 13rd to March 14th, 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

[3] Iastech is the company responsible for the maintenance in the Biogás supervisory system (PLC).

		punctual by Biogás Energia Ambiental because it had never happened before; The Biogás dismissed two days of production (March 13th and March 14th). On March 15th, data were recorded normally.
04	On April 16th, 2012, the electricity generated was smaller than the normal because the Biogás Energia Ambiental realized a preventive maintenance in the 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;
05	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. Maintenance was performed in the main manifold for 5 days and the disruption was corrected. The event occurred was considered punctual by Biogas Energia Ambiental because this kind of maintenance had never happened before; The problems in its main manifold resulted in less exported electricity and biogas producting during this period.
06	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[4] 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.

[4] Seven engines was the average for this monitoring period, so at times more than seven engines were in operation.

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 revalidated Monitoring Plan:

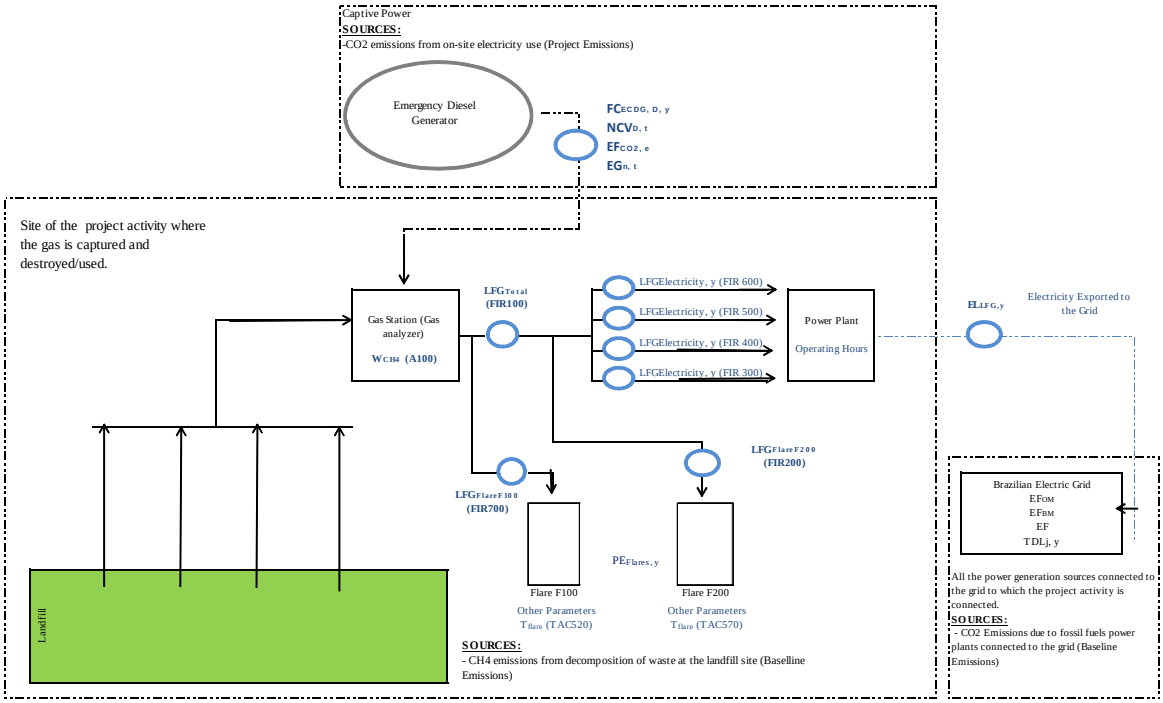


Figure 8 - Lay-out of the Degassing Station.

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. re-activated this secondary line and installed 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 measures the LFG collected and sent exclusively to the flare F200; and
- FIR200 measures 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
$LFG_{Total, y}$	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 or the last issuance of CERs for this project activity, whichever occurs later	Measured by a meter. Data will be aggregated monthly and yearly.
$LFG_{Flare, y}$	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 or the last issuance of CERs for this project activity, whichever occurs later	Measured by a flow meter, located in the main gas line. Normal cubic meters represent the gas volume in cubic meters at STP. Data will be aggregated monthly and yearly. 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.
$LFG_{Electricity, y}$	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 or the last issuance of CERs for this project activity, whichever occurs later	Measured by 4 flow meters. Data will be aggregated daily, monthly and yearly.
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

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
								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
$PE_{Flares,y}$	Project emissions from flaring of the residual gas stream.	tCO_2e	N/A	C	N/A	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	Calculate as per the Version 01 of the Tool to determinate project emission from flaring gases containing methane.
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 or the last issuance of CERs for this project activity, whichever occurs later	Measured by continuous gas quality analyzer.
$EL_{LFG,y}$	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 or the last issuance of CERs for this project activity, whichever occurs later	Measured by electricity meters located in the substation connected to the SIN.

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
Operation of the energy plant	Operation of the energy plant	Hours	N/A	M	Hourly	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	Readings from the run-time meter installed at each engine.
EF_{OM}	Emission factor of the operating margin	tCO_2e/MWh	N/A	M	Monthly	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	This variable is monitored ex-post by the CIMGC and is updated monthly in their web-site
EF_{BM}	Emission factor of the built margin	tCO_2e/MWh	N/A	M	Yearly	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	This variable is monitored ex-post by the CIMGC ("**Comissão Interministerial de Mudança Global do Clima**") – (Interministerial Commission on Global Climate Change) and is updated yearly in their web-site
$PE_{ec,y}$	Project emission from electricity consumption by the project activity	tCO_2	N/A	C	N/A	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	Calculated as per version 01 of the Tool to calculate baseline, project and/or leakage emission from electricity consuption
$PE_{fc,y}$	Project emission from fossil fuel combustion	tCO_2	N/A	C	N/A	E	During the crediting period and two years or the last	Calculated as per version 02 of the Tool to calculate project or leakage CO_2 emission

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
							issuance of CERs for this project activity, whichever occurs later	from fossil fuel combustion
$fv_{i,h}$	Volumetric fraction of component i in the residual gas in the hour h	-	A 100	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later	Continuous measurement using a certified gas analyzer.
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basic at normal conditions conditions in the hour h.	m^3/h	FIR200 and FIR700	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later	Continuous measurements from the flow meters
Other flare operation parameters	Data and parameter that are required to monitor whether the flare operates within the range of operating conditions according to the manufacturer's specification	N/A	TAC 520 (F100) TAC 570 (F200)	M	Continuously	E	All registration will be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later	Data is measured by a thermocouple installed in each flare.
$FC_{ECDG,D,y}$	Quantity of diesel fired in the emergency captive diesel generator	L	N/A	M	Continuously	E/P	All registration will be kept for 2 years after the end of the	Continuous measurements by from the mass/volume meter. For this monitoring

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
							crediting period or the last issuance of CERs for this project activity, whichever occurs later	period the value adopted is a default according the manual of equipment.
$NCV_{D,t}$	Average net calorific value of the diesel used in the period t	GJ/volume unit	N/A	-	N/A	E	All registration will be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later	Average net calorific power of the diesel. Accomplish the Brazilian Energy Balance (BEB).
$EF_{CO2,e}$	CO2 emission factor of the diesel used in the period	tCO_2/TJ	N/A	-	N/A	E	All registration will be kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later	Accomplish the IPCC guidelines
$EL_{LFG,y}$[5]	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 periodor the last issuance of CERs for this project activity, whichever	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

[5] Monitoring parameters as per methodology ACM0001 – version 11 – Tool to calculate Project or Leakage CO2 emissions from fossil fuel.

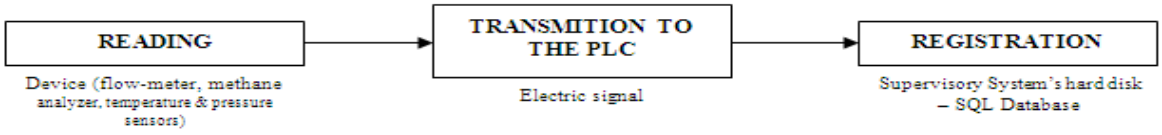
PDD ID	Data variable	Data Unit	TAG Equipment	Measured (M) Calculated (C) Estimated (E)	Recording frequency	Data achievement: Electronic (E) Paper (P)	For how long is archived data kept?	Comment
							occurs later	Eletropaulo (Electric Utility). Each set of meter is connected to the responsible supervisory system, which registers continuously the electricity exported.
$EF = CEF_{elecy,BL,y}$	Electricity Baseline Emission Factor	tCO_2/MWh	N/A	C	The EFOM is updated monthly and EFBM updated yearly by CIMGC	E	During the crediting period and two years or the last issuance of CERs for this project activity, whichever occurs later	This variable was calculated according with the ex-post monitoring of EF_{OM} and EF_{BM} by the CIMGC.

Data Acquisition:

The variables monitored in the degassing station by Biogás Energia Ambiental 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 4 - 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 23:59, 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)
$LFG_{Flare,y}$ $FV_{RG,h}$	FIR200 FIR700				
$LFG_{Electricity, y}$	FIR300 FIR400 FIR500 FIR600				

Methodology ID	Equipment TAG	Reading Frequency	Transmition Frequency	Registration Frequency	Comments
T_{Flare} ; Other flare operation parameters.	TAC520 and TAC570	Continuously	Continuously	Every 5 minutes	- Temperatures below 1,000ºC 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_Verification_Calculation Spreadsheet – referring to the CER Calculation)
$w_{CH4, y}$ fvi,h	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 15 minutes. Data is compared with Eletropaulo's invoices. - Responsibilities of the routine: PLC (continuously) and Sotreq's plant supervisor (monthly)
$FC_{ECDG,D,y}$	N/A	-	-	-	- For this monitoring period the value adopted is a default according the manual of equipment
Operation of the energy plant	N/A	Continuously	Continuously	Hourly	- Amounts recorded by the Sotreq PLC. - Responsibilities of the routine: PLC (continuously) and Sotreq's plant supervisor (monthly)

Involvement of third parties:

BFLGE has one third part involved:

- Sotreq[6], the company responsible for the electricity generation 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 procedures which objective is to specify the monitoring procedures made inside the Degassing Station, as gas flows, 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

[6] Company contracted by ITAU-UNIBANCO to operate the power plant.

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:

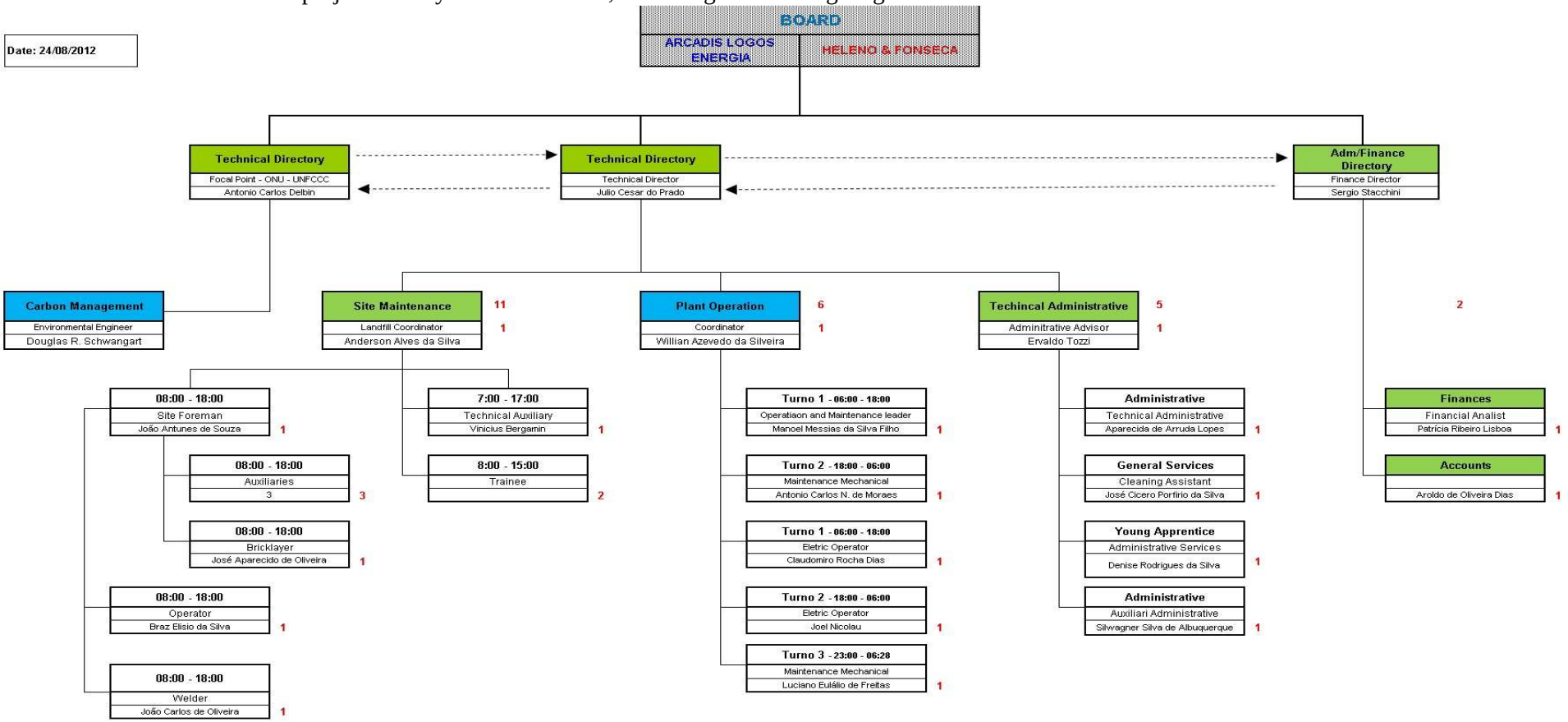


Figure 10 - General Organogram of Biogás

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 landfill coordinator and/or the coordinator of the plant operation are determined as presented in the figure below:

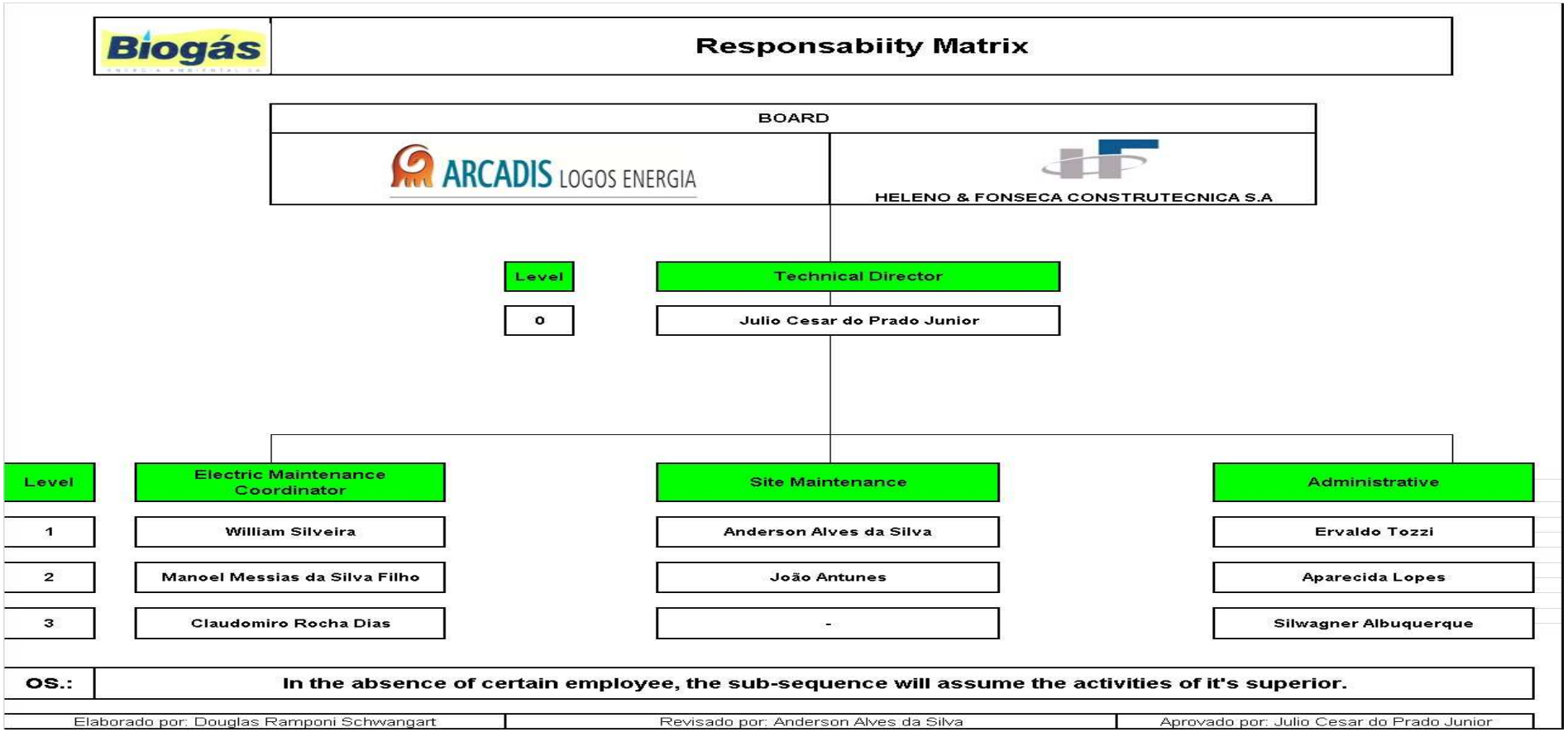


Figure 11 - Responsibility Matrix of Biogás Energia Ambiental

Trainings:
All training was supplied to operator before the project's implementation. The training certificates were presented to the DOE in previous verifications.

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}**
Unit:	tCO_2e/tCH_4
Description:	Global Warming Potential value for methane
Source of data :	IPCC
Value(s) applied :	21
Purpose of data:	Baseline calculation
Additional comment:	N/A

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

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

Data / Parameter:	**Regulatory requirements relating to landfill gas project**
Unit:	%

Description:	Regulatory requirements relating to landfill gas projects
Source of data:	Publicly available information of the host country's regulatory requirements relating to landfill gas. In Brazil there are neither regulatory requirements nor legal obligations to destroy the LFG.
Value(s) applied:	There are neither regulatory requirements nor legal obligations to destroy the LFG.
Purpose of data	Baseline emission calculation
Additional comment	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period – variable updated at renewal of each credit period.

D.2. Data and parameters monitored

Data / Parameter:	**$LFG_{Total, y}$**
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:	FIR100= 47,932.1455 Nm^3; FIR700= 0.00 Nm^3. For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN"
Monitoring equipment:	
Measuring/ Reading/ Recording frequency:	Continuous readings from the flow-meters FIR100 and FIR700 installed. The equipments are connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated daily, monthly and yearly. The supervisory system makes records of instant gas-flow every 5 minutes and the accumulated gas-flow every hour. The counter is reseted at 00:00.
Calculation method (if applicable):	N/A
QA/QC procedures :	Flow meters are subject to a regular maintenance and testing regime to

Equipment	TAG	Manufacturer	Model	Serial Number	maximum accuracy (%)	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	1.5	25/04/2007	25/04/2012
2) Flow-meter	FIR 100	FCI	ST51-1F33FM00	341992	2.5	29/04/2011	29/04/2016
3) Flow meter	FIR 700	FCI	ST 51	328849	2.5	08/09/2010	08/09/2015

	ensure accuracy. Regular maintenance will be made along with the calibration, following general guidelines from the manufacturer Regarding the calibration of the instrument, the PPs decided to conservatively adopt a 5-years frequency because: - in compliance with national laws (example in Germany the Netherlands, for turbine meters of this size of FIR100 and FIR700, calibration is never required; - in Brazil there are no requirements on how often flow-meters must be calibrated;). - in Germany, a calibration every 10-years is enforce by law; - the manufacturer states that it‟s up to the clients to determine the calibration frequency. The procedure SGA IT 4.4.6-29 explains that the operator must check the operational conditions for this kind of instrument, at least once a day. In the flow meters case if the operator identifies some problem, the instruments must be replaced or calibrated. All registration will be kept for 2 years after the end of the crediting period.
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 (FIR200, FIR300, FIR400, FIR500 and FIR600). 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. The equipment error is too the maximum accuracy. 2) This flow meter is in operation since 16/08/2011. The equipment error is too the maximum accuracy. 3) This flow meter was installed on 12th November, 2010. The equipment error is too the maximum accuracy.

Data / Parameter:	**$LFG_{Flare, y}$**
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:	FIR200= 0.00 Nm^3; FIR700= 0.00 Nm^3. For more details see ER excel file, “BLFGE_18th_Verification_Calculation Spreadsheet” in worksheet “DATA_EN”

Monitoring equipment:

Equipment	TAG	Manufacturer	Model	Serial Number	Maximum accuracy (%)	Date of the last calibration	Date of the next calibration
Turbine Flow-meters	FIR200	Incontrol	VTGEX-200	VG15239	1.00	01/07/09	01/07/14
Flow-meter	FIR700	FCI	ST51	328849	2.5	08/09/10	08/09/15
Pressure Transmit	FIR200	SMAR	LD291	L454793/ L42236	0.2	27/03/09	27/03/14

	ter	FIR700[7]	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:	Continuous readings from the flow-meters FIR200 and FIR700 installed. The instruments are connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated daily, monthly and yearly. The supervisory system makes records of instant gas-flow every 5 minutes and the accumulated gas-flow every hour. The counter is reseted at 00:00.							
Calculation method (if applicable):	N/A							
QA/QC procedures :	Flow meters should be subject to a regular maintenance and testing regime to ensure accuracy, in compliance with national laws. Regular maintenance will be made along with the calibration, following general guidelines from the manufacturer Regarding the calibration of the instrument, the PPs decided to conservatively adopt a 5-years frequency because: - in the Netherlands, for turbine meters of this size of FIR200 and FIR700, calibration is never required; - in Brazil there are no requirements on how often flow-meters must be calibrated; - in Germany, a calibration every 10-years is enforce by law; - the manufacturer states that it‟s up to the clients to determine the calibration frequency. 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 instruments must be replaced or calibrated. All registration will be kept for 2 years after the end of the crediting period.							
Purpose of data:	Baseline emission calculation							
Additional comment:	For this monitoring period, these values were dismissed.							

Data / Parameter:	$LFG_{Electricity, y}$							
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 (FIR300, FIR400, FIR500 and FIR600)							
Source of data:	PLC data records							
Value(s) of monitored parameter:	FIR300= 6,144,055.8540; FIR400= 6,564,034.3347 ; FIR500= 10,310,575.0687; FIR600= 10,328,055.7489 For more details see ER excel file, “BLFGE_18th_Verification_Calculation Spreadsheet” in worksheet “DATA_EN”							
Monitoring equipment:	**Equipment**	**TAG**	**Manufacturer**	**Model**	**Serial Number**	**Maximum**	**Date of the last**	**Date of the next**

[7] 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.

						accuracy (%)	calibration	calibration
	Turbine Flow-meters	FIR300	Incontrol	VTG EX-200	VG083B6	1.0	12/12/06	12/12/2011
		FIR400			VG084B6	1.0		
		FIR500			VG086B6	1.0		
		FIR600			VG085B6	1.0		
	Turbine Flow-meters	FIR300	Incontrol	VTG EX-200	VG083B6	1.0	03/11/2011	03/11/2016
		FIR400			VG084B6	1.0	10/03/2011	10/03/2016
		FIR500			VG086B6	1.0	14/12/2011	14/12/2016
		FIR600			VG085B6	1.0	14/09/2011	15/09/2016
	Pressure Transmitter	FIR300	SMAR	LD291	33007-06	0.2	06/05/09	06/05/14
		FIR400			L454794/ L42237	0.2	27/03/09	27/03/14
		FIR500			33006-06	0.2	23/06/09	23/06/14
		FIR600			33005-06	0.2	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:	Continuous readings from the 4 flow-meters installed (tags FIR300, FIR400, FIR500 and FIR600). The equipments are connected to a supervisory computer system, which registers continuously the LFG measured. Data to be aggregated daily, monthly and yearly. For each flow-meter, the supervisory system makes records of instant gas-flow every 5 minutes and the accumulated gas-flow every hour. The counter is reseted at 00:00hs.
Calculation method (if applicable):	N/A
QA/QC procedures :	Flow meters are subject to a regular maintenance and testing regime to ensure accuracy, in compliance with national laws. Regular maintenance will be made along with the calibration, following general guidelines from the manufacturer. Regarding the calibration of the instrument, the PPs decided to conservatively adopt a 5-years frequency because: - in the Netherlands, for turbine meters of this size of FIR300, FIR400, FIR500 and FIR600, calibration is never required; - in Brazil there are no requirements on how often flow-meters must be calibrated; - in Germany, a calibration every 10-years is enforce by law; - the manufacturer states that it‟s up to the clients to determine the calibration frequency. 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 instruments must be replaced or calibrated. All registration will be kept for 2 years after the end of the crediting period.

Purpose of data:	Baseline emission calculation
Additional comment:	These flow meters (FIR300, FIR400, FIR500, FIR600) were re-calibrated. Since Biogas has four lines that send the gas to the engines, one per meter (FIR300, FIR 400, FIR 500 and FIR 600), during the period of re-calibration of each meter, the respective line of the meter in calibration was closed until its return. For the temperature transmitter of the FIR 300, FIR 400, FIR 500 and FIR 600 was used the error of the calibration because is higher than the maximum accuracy. The calibration of FIR500 delayed a few days, but did not generate any impact because the error of 1% adopted by the PP is the maximum error of the instrument.

Data / Parameter:	T_{Flare}
Unit:	°C
Description:	Temperature of the exhaust gas in the flare F100 and F200
Measured /Calculated /Default:	Measured
Source of data:	PLC data records
Value(s) of monitored parameter:	-
Monitoring equipment:	(see table below)
Measuring/ Reading/ Recording frequency:	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. The thermocouples are calibrated every year.
Calculation method (if applicable):	N/A
QA/QC procedures :	Thermocouples are replaced or calibrated every year. All registration will be kept for 2 years after the end of the crediting period.
Purpose of data:	Baseline emission calculation
Additional comment:	For this monitoring period, the ERs from the flares were dismissed. For this monitoring period the calibration of the thermocouples was on delay, however the ERs from the flares were dismissed.

Equipment	TAG	Manufacturer	Model	Serial Number	Maximum accuracy (%)	Date of the last calibration	Date of the next calibration[8]
Thermocouple F100	TAC520	Jumo	type "S" L750	32950/030	N/A	24/08/2011	24/08/2012
Thermocouple F200	TAC570	Jumo	type "S" L750	32411/030	N/A	19/09/2011	19/09/2012

Data / Parameter:	$PE_{Flares, y}$
Unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in year y
Measured /Calculated /Default:	Calculated

[8] Because of the operational failure, the thermocouples were not calibrated at the actual due date. Calibration certificates of the upcoming calibration will be presented at the next verification.

Source of data:	Calculated as per version 01 of the tool to determine project emissions from flaring gases containing methane.
Value(s) of monitored parameter:	0.00 tCO_2e For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "Consolidated_EN".
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Calculated as per version 01 of the tool to determine project emissions from flaring gases containing methane
Calculation method (if applicable):	Calculated as per version 01 of the tool to determine project emissions from flaring gases containing methane**.**
QA/QC procedures :	N/A
Purpose of data:	Calculated the project emissions from flaring gases containing methane
Additional comment:	N/A

Data / Parameter:	$\mathbf{W_{CH4,y}}$
Unit:	$\mathbf{m^3CH_4/m^3LFG}$
Description:	Methane fraction in the landfill gas.
Measured /Calculated /Default:	Measured
Source of data:	PLC data records.
Value(s) of monitored parameter:	Daily average for the monitoring period : 47.6752 % For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN".
Monitoring equipment:	Manufacturer: Rosemount - NUK Type: Binos 100M TAG: A100 Accuracy class: 1.0000% (error) Serial number: 99965398 Calibration frequency: weekly, with a standard certified gas cylinder 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 recorded 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; - The operation team is responsible for the testing/maintenance according to procedure SGA IT 4.4.6-10; - 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 weekly using a standard certified gas. All registration will be kept for 2 years after the end of the crediting period.
Purpose of data:	Baseline emission calculation
Additional comment:	For this monitoring period had two days with the delay of calibration

	(22/12/2010; 13/06/2012). In the "BLFGE_18th_Verification_Calculation Spreadsheet" has been added a worksheet explaining the procedure according to the paragraph 238 of the VVS.

Data / Parameter:	$EL_{LFG,y}$
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:	87,860.5497 MWh For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN".
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: 29/10/2011 2)Date of last calibration: 16/04/2012 Validity: 15/04/2014 Manufacturer: Merlin Gerin Type: Power Logic – CM4000 TAG: Not applicable Accuracy class: 1.0000% (error) Serial number: 0011001426 Calibration frequency: 2 years 1)Date of last calibration: 30/10/2009 Validity: 29/10/2011 2)Date of last calibration: 16/04/2012 Validity: 15/04/2014
Measuring/ Reading/ Recording frequency:	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 has 2 meters installed and both of them are connected to the responsible supervisory system, which registers continuously the electricity exported. For sake of conservativeness, both records will be compared in a monthly basis and the lowest one will be applied to calculate ERs.
Calculation method (if applicable):	N/A
QA/QC procedures :	Electricity meters are subject to regular maintenance following

	ONS procedure (every 2-years, according with Network Procedures, from ONS – Operador Nacional do Sistema[9]). The meter´s supplier (Merlin Gerin) manual mentions that regular maintenance for the Power Logic CM4000 electricity meters is not necessary.All registration will be kept for 2 years after the end of the crediting period.
Purpose of data:	Baseline emission calculation
Additional comment:	1) Monitoring under responsibility of the Biogeração Manager. 2) For December/2010, Biogas used the data from Eletropaulo website, sent by Biogeração (Sotreq) to compare the energy data. For the other months Biogas used the data from Biogeração and compare with the data from Eletropaulo, as mentioned above. 3) For this monitoring period, there was a delay in the calibration of power meters Biogeração, however, it was found that there were no changes in the record of energy generated. As the adopted error(1%) is higher than shown in the calibration certificate and the maximum accuracy of the instrument, this was maintained.

Data / Parameter:	**Operation of the energy plant**
Unit:	Hours
Description:	Operation of the energy plant
Measured /Calculated /Default:	Measured
Source of data:	Readings from the run-time meter installed at each engine and the registered data from Sotreq's PLC.
Value(s) of monitored parameter:	Daily average for the monitoring period: 193 h For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN".
Monitoring equipment:	Run-time meter installed at each engine
Measuring/ Reading/ Recording frequency:	Hourly
Calculation method (if applicable):	Continuous readings from the run-time meter installed in the control room. The equipment is connected to Biogeração's computer system, which registers continuously the quantity of hours the engines operated.
QA/QC procedures :	All registration will be kept for 2 years after the end of the crediting period.
Purpose of data:	This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational. This value was not used to calculate monitored ERs.
Additional comment:	The calibration of hour meters is not necessary, as this instrument does not create a impact on the amount of power generated or the amount of captured biogas, serving only to indicate the periodicity of engine maintenance.

[9] "NATIONAL SYSTEM OPERATOR; submodule 12.3 - maintenance of the measurement system for invoicing , Rev 1.1 (18/06/2010), avaliable at http://www.ons.org.br/download/procedimentos/modulos/Modulo_12/Submodulo%2012.3_Rev_1.1.pdf. Accessed on 01/02/2011".

Data / Parameter:	**EF_{OM}**
Unit:	tCO2e/MWh
Description:	CO_2 emission intensity of the electricity
Measured /Calculated /Default:	Calculated by Comissão Interministerial de Mudança Global do Clima **(**CIMGC) - Interministerial Commission on Global Climate Change.
Source of data:	Brazilian Grid - CIMGC
Value(s) of monitored parameter:	2010 – 0.4787 2011 – 0.2920 2012 – 0.5176
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	This variable is monitored *ex-post* by the CIMGC and is updated monthly in their web-site (http:http://www.mct.gov.br/index.php/content/view/72764/Fatores_de_Emissao_de_CO_sub_2_sub__pela_geracao_de_energia_eletrica_no_Sistema_Interligado_Nacional_do_Brasil.html).
Calculation method (if applicable):	N/A
QA/QC procedures :	The CIMGC calculate the hourly and the consolidated monthly value of EFOM, based on information from the national electric sector.
Purpose of data:	Baseline emission calculation
Additional comment:	N/A

Data / Parameter:	**EF_{BM}**
Unit:	tCO2e/MWh
Description:	Emission Factor of the Built Margin
Measured /Calculated /Default:	Calculated by CIMGC
Source of data:	Brazilian Grid - CIMGC
Value(s) of monitored parameter:	2010 – 0.1404 2011 – 0.1056 2012 – 0.2010
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	This variable is monitored *ex-post* by the CIMGC and is updated annually[10] in their web-site.
Calculation method (if applicable):	N/A
QA/QC procedures :	The CIMGC calculates the annual value of EF_{BM}, based on information from the national electric sector.
Purpose of data:	Baseline calculation
Additional comment:	N/A

Data / Parameter:	**$CEF_{elecy,BL,y}$ = EF**
Unit:	tCO2e/MWh
Description:	Carbon emission factor of electricity
Measured /Calculated /Default:	Calculated
Source of data:	Brazilian Grid – CIMGC (OM and BM)
Value(s) of monitored parameter:	2010 – 0.22497 2011 – 0.152

[10] This variable is updated annually. In the PDD was a typo.

	2012 – 0.2802
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	This variable is calculated according with the ex-post monitoring of EFOM and EFBM by the CIMGC.
Calculation method (if applicable):	CIMGC is responsible for calculating the $CEF_{Elec, BL, y}$. The OM is updated monthly and the BM is updated yearly
QA/QC procedures :	QA/QC under responsibility of CIMGC
Purpose of data:	Baseline Calculation
Additional comment:	For more information, please refer to the parameters EF_{OM} and EF_{BM} above.

Data / Parameter:	**$PE_{ec, y}$**
Unit:	tCO_2
Description:	Project emissions from electricity consumption by the project activity during the year y
Measured /Calculated /Default:	Calculated
Source of data:	Calculated as per Version 01 of the tool to calculate baseline, project and/or leakage emissions from electricity consumption
Value(s) of monitored parameter:	38 tCO_2 For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "Consolidated_EN".
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Calculated as per Version 01 of the tool to calculate baseline, project and/or leakage emissions from electricity consumption
Calculation method (if applicable):	Calculated as per Version 01 of the tool to calculate baseline, project and/or leakage emissions from electricity consumption from diesel generation
QA/QC procedures :	N/A
Purpose of data:	Calculate project emissions from electricity consumption from the diesel generator.
Additional comment:	The project has one backup system in case of power supply interruption: consumption from a captive diesel generator, located inside the landfill.

Data / Parameter:	**$PE_{fc, y}$**
Unit:	tCO_2
Description:	Project emissions from fossil fuel combustion during the year y
Measured /Calculated /Default:	Calculated
Source of data:	Calculated as per Version 02 of the Tool to calculate project or leakage CO2 emission from fossil fuel combustion
Value(s) of monitored parameter:	0
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	Calculated as per Version 02 of the Tool to calculate project or leakage CO2 emission from fossil fuel combustion
QA/QC procedures :	Calculated as per Version 02 of the Tool to calculate project or leakage CO2 emission from fossil fuel combustion

Purpose of data:	Baseline emission calculation
Additional comment:	There is no on-site fossil fuel consumption due to the project actiity other than for electricity generation. The fossil fuel consumption by the emergency diesel generator for electricity generation has been considered by PEec,y.

Data / Parameter:	**$fv_{i,h}$**
Unit:	-
Description:	Volumetric fraction of component i in the residual gas in the hour h where *i*= CH_4, CO, CO_2, O_2, H_2, N_2
Measured /Calculated /Default:	Measured
Source of data:	Continuous measurement using a certified gas analyzer.
Value(s) of monitored parameter:	Please, refer to "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN".
Monitoring equipment:	Please refer to parameter wCH4,y
Measuring/ Reading/ Recording frequency:	As the residual gas temperature does not exceed 60°C, the requirement that flow rate and methane content measurements have to be carried out with the same basis (dry or wet) is not applicable.
Calculation method (if applicable):	N/A.
QA/QC procedures :	The gas analyzer is recalibrated every week against a standard certified gas cylinder, according with an internal procedure.
Purpose of data:	Baseline emission calculation
Additional comment:	As a simplified approach, only the methane content of the residual gas measured and the remaining part will be considered as N2.

Data / Parameter:	**$FV_{RG,h}$**
Unit:	m^3/h
Description:	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*
Measured /Calculated /Default:	Measured
Source of data:	Continuous measurements from the flow-meters FIR200 and FIR700.
Value(s) of monitored parameter:	Please, refer to "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "DATA_EN".
Monitoring equipment:	FIR200 and FIR700. Please refer to $LGF_{flare,y}$
Measuring/ Reading/ Recording frequency:	As the residual gas temperature does not exceed 60°C, the requirement that flow rate and methane content measurements have to be carried out with the same basis (dry or wet) is not applicable.
Calculation method (if applicable):	N/A
QA/QC procedures :	Flow meters are periodically calibrated (PPs decided to conservatively adopt a 5-years frequency). Please refer to $LGF_{flare,y.}$
Purpose of data:	Baseline emission calculation
Additional comment:	N/A

Data / Parameter:	**Other flare operation parameters**
Unit:	N/A
Description:	Data and parameters that are required to monitor whether the flare operates within the range of operating conditions according to the

	manufacturer's specifications
Measured /Calculated /Default:	Measured
Source of data:	PLC data records
Value(s) of monitored parameter:	-
Monitoring equipment:	Please refer to T_{flare}
Measuring/ Reading/ Recording frequency:	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.
Calculation method (if applicable):	N/A
QA/QC procedures :	Thermocouples are replaced or calibrated every year.
Purpose of data:	Baseline emission calculation
Additional comment:	Temperatures below 1,000° and above 1,200° indicate that the flare is out of the specified conditions. 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 activated. For this monitoring period all gas sent to flares was not considered in the ER calculation.

Data / Parameter:	**$FC_{ECDG, D, y}$**
Unit:	Volume unit (L)
Description:	Quantity of diesel fired in the emergency captive diesel generator in year *y*
Measured /Calculated /Default:	Default, for this monitoring period.
Source of data:	Equipment Manual
Value(s) of monitored parameter:	9,988.00 (L) For more details see ER excel file, "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "Consolidated_EN".
Monitoring equipment:	N/A, for this monitoring period as not having installed a volume meter, the PP chose to use the maximum consumption(44L/h) of the diesel oil in generator diesel in one hour of operation.
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures :	The metered fuel consumption quantities are based on purchased quantities and stock changes. All registration will be kept for 2 years after the end of the crediting period.
Purpose of data:	Project emission calculation
Additional comment:	All registrations are kept for 2 years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later; For this monitoring period, for not having installed a volume meter, the PP chose to use the maximum consumption of the diesel oil in generator diesel in one hour of operation. This is considered as a temporary deviation as per project standard, Appendix 1, paragraph 3

	which will be corrected for the next monitoring period. Hence it is not necessary to revise the monitoring plan. The values considered and the calculations are presented in the worksheet "BLFGE_18th_Verification_Calculation Spreadsheet". The maximum consumption of the diesel generator in one hour of operation is 0.125 MWh.

Data / Parameter:	**$NCV_{D,t}$**
Unit:	GJ/ (L)
Description:	Average net calorific value of the diesel used in the period *t*
Measured /Calculated /Default:	Default
Source of data:	Table VIII.9 – Specific Mass and Heating Values, page 218, Brazilian Energy Balance 2013 – Final Report.. (www. ben.epe.gov.br).¶
Value(s) of monitored parameter:	0.05034
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures :	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 1 of the 2006 IPCC Guidelines. If the values fall out this range, there will be necessary to collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data:	Project emission calculation
Additional comment:	Accomplish Brazilian Energy Balance (BEB). To be more conservative than the value of 2006 IPCC Guidelines, the value of BEB was used.

Data / Parameter:	**$EF_{CO2,e}$**
Unit:	tCO_2/GJ
Description:	CO_2 emission factor of the diesel used in the period *t*
Measured /Calculated /Default:	Default
Source of data:	Chapter 1, Table 2.2, Vol. 2 of the 2006 IPCC Guidelines.
Value(s) of monitored parameter:	0.0741
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	N/A
Calculation method (if applicable):	N/A
QA/QC procedures :	a) The supplier shall inform the value of the emission factor in the purchase invoices or shall present the results of laboratory analysis; b) The values listed in the latest BEN (Balanço Energético Nacional) and BESP (Balanço Energético do Estado de São Paulo) will be compared and the higher will be applied; c) The latest revision of the IPCC Guidelines will be taken into account.

Purpose of data:	Project emission calculation.
Additional comment:	Accomplish the 2006 IPCC Guidelines. The IPCC default value was used, to be more conservative than Energy Balance of the State of São Paulo 2013 (0.0704 tCO2/GJ). The diesel generator is used as a backup when the power generation is interrupted.

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[11] 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:

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

Where:

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

[11] 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.

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

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:

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

$$MD_{flare\ F100,\ y} = (LFG_{FIR\ 200,\ y} \times w_{CH4} \times D_{CH4}) - (PE_{flare\ F100,\ y}/GWP_{CH4})$$

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);
$LFG_{FIR\ 200,y}$ = Quantity of landfill gas flared in F100 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)
$PE_{flare\ F100,y}$ = Project emissions from flaring of the residual gas stream in flare F100 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});
GWP_{CH4}=Global Warming Potential of methane valid for the commitment period;

STEP1: Determination of the mass flow rate of the residual gas that is flared

$$FM_{RG,\ h} = \frac{P_n}{\frac{R_n}{\sum(fv_{i,\ h} \times MM_i)} \times T_n} \times FV_{RG,\ h}$$

$FM_{RG,\ h}$= Mass flow rate of the residual gas in hour *h* (kg/h)*;*
P_n = Atmospheric pressure at normal conditions (101,325 Pa);
R_n= Universal ideal gas constant (8,314 $Pa.m^3/kmol.K$);
T_n= Temperature at normal conditions (273.15 K);
$fv_{i,\ h}$= Volumetric fraction of component i in the residual gas in the hour *h;*
MM_i= Molecular mass of residual gas component *i* (kg/kmol);
$FV_{RG,\ h}$= Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h* (m^3/h);
i= The components CH_4, CO, CO_2, O_2, H_2, N_2

As a simplified approach, BLFGE will only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N_2).

Step 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

$$fm_{j,h} = \frac{\sum fv_{i,h} \times AM_j \times NA_{j,i}}{\sum \left(fv_{i,h} \times MM_i \right)}$$

$fm_{j,h}$= Mass fraction of element j in the residual gas in hour *h;*
$fv_{i,h}$= Volumetric fraction of component i in the residual gas in the hour *h;*
AM_j= Atomic mass of element *j* (kg/kmol);
$NA_{j,i}$= Number of atoms of element *j* in component *i;*
j= The elements carbon, hydrogen, oxygen and nitrogen;
MM_i= Molecular mass of residual gas component *i* (kg/kmol);
i= The components CH_4, CO, CO_2, O_2,H_2, N_2

STEP 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis
Is not applicable as the project will apply the default value of 90% Flare Efficiency, through monitoring of the flare temperature and other parameters (i.e. compliance with the manufacturer's specifications).

STEP 4: Determination of methane mass flow rate in the exhaust gas on a dry basis
Is not applicable as the project will apply the default value of 90% Flare Efficiency, through monitoring of the flare temperature and other parameters (i.e. compliance with the manufacturer's specifications).

STEP 5: Determination of methane mass flow rate in the residual gas on a dry basis

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH_4,FG,h} \times \rho_{CH_4,n}$$

$TM_{RG,h}$= Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h* (kg/h);
$FV_{n,RG,h}$= Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m^3/h));
$fv_{CH4,FG,h}$= Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h* (mg/m^3);
$\rho_{CH4,n}$= Density of methane at normal conditions (0.716 kg/m^3).

STEP 6: Determination of the hourly flare efficiency
As the BLFGE have enclosed flares and the default value of flare efficiency will be adopted, the flare efficiency in the hour h ($\eta_{flare,h}$) is
• 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour h.
• 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h, but the manufacturer‟s specifications on proper operation of the flare are not met at any point in time during the hour h.

• 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h and the manufacturer‟s specifications on proper operation of the flare are met continuously during the hour h.

STEP 7. Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour h, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour h ($\eta_{flare,\,h}$), as follows:

$$PE_{flare\ F100,\ y} = \left(\sum_{h=1}^{8760} TM_{RG,\,h} \times (1-\eta_{flare,\,h}) x (GWP_{CH4}/1000)\right.$$

Where:

$PE_{flare,y}$=Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$=Mass flow rate of methane in the residual gas in the hour h
$\eta_{flare,h}$=Flare efficiency in hour h
GWP_{CH4}=Global Warming Potential of methane valid for the commitment period

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

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

$$MD_{flare\ F200,\ y} = (LFG_{FIR700,\,y} \times w_{CH4} \times D_{CH4}) - (PE_{flare\ F200,\,y}/GWP_{CH4})$$

Where:

$\mathbf{MD_{flareF200,y}}$ = Quantity of methane destroyed in the flare F200 (tCH4);
$\mathbf{LFG_{FIR\ 700,y}}$ = Quantity of landfill gas flared during the year measured in cubic meters (Nm^3);$\mathbf{PE_{flare\ F200,y}}$ = 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*.

$$PE_{flare\ F200,\ y} = \left(\sum_{h=1}^{8760} TM_{RG,\,h} \times (1-\eta_{flare,\,h}) x (GWP_{CH4}/1000)\right.$$

Where:

$PE_{flare,y}$=Project emissions from flaring of the residual gas stream in year y
$TM_{RG,h}$=Mass flow rate of methane in the residual gas in the hour h
$\eta_{flare,h}$=Flare efficiency in hour h
GWP_{CH4}=Global Warming Potential of methane valid for the commitment period

The $\mathbf{MD_{electricity,\ y}}$ 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:

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

According with the tool, BLFGE corresponds to Scenarios B:

- Scenario B (operation of the emergency captive diesel generator): *One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.*

Project Emissions Calculation in Scenario B
For the calculation of project emissions in Scenario B, the following equation is used:

$$PE_{EC,\ Scenario\ B,\ y} = \sum_{j} EC_{PJ,\ j,y} \times EF_{EL,\ j,\ y} \times \left(1 + TDL_{j,\ y}\right) \quad \textbf{(1)}$$

Where:
$PE_{EC,\ Scenario\ B,\ y}$ = Project emissions from electricity consumption in Scenario B, in year y (tCO_2/yr)
$EC_{PJ,\ j,\ y}$ = Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
$EF_{EJ,\ j,\ y}$ = Emission factor for electricity generation for source *j* in year *y* (tCO_2/MWh)
$TDL_{j,\ y}$ = Average technical transmission and distribution losses for providing electricity to source *j* in year *y*

The project applies option B1 to calculate the emission factor, with the following assumptions:

- $TDL_{j,\ y}$ = 0, as there are no loses in the electricity transmission once the diesel generator is located inside BLFGE;

- Index *j* corresponds to the Emergency Captive Diesel Generator (ECDG); and

- $EF_{EL,\ j,\ y} = EF_{EL,\ DG,\ y}$ is calculated according as follows:

$$EF_{EL,\ ECDG,\ y} = \frac{\sum_{j}\sum_{j} FC_{n,\ i,t} \times NCV_{i,\ t} \times EF_{CO2,\ i,\ t}}{\sum_{n} EG_{n,t}} \quad \textbf{(2)}$$

Where:
$EF_{EL,\ ECDG,\ y}$ = Emission factor for the Emergency Captive Diesel Generator (ECDG) in year *y* (tCO_2/MWh)
$FC_{n,\ i,\ t}$ = Quantity of fossil fuel type *i* fired in the captive power plant *n* in the time period *t* (mass

or volume unit)

$NCV_{i, t}$ = Average net calorific value of fossil fuel type *i* used in the period *t* (GJ/mass or volume unit)

$EF_{CO2, i, t}$ = Average CO_2 emission factor of fossil fuel type *i* used in the period *t* (tCO_2/GJ)

$EG_{n, t}$ = Quantity of electricity generated in captive power plant *n* in the time period *t* (MWh)

J = Sources of electricity consumption in the project (ECDG = Emergency Captive Diesel Generator)

n = Fossil fuel fired captive power plants installed at the site of the electricity consumption source *j*. For BLFGE, *n* corresponds to Diesel (D);

t = Time period for which the emission factor for electricity generation is determined. For BLFGE, *t* corresponds to the monitoring period (e.g. the year *y*)

Thus, the two above equations are updated to:

$$PE_{EC, Scenario\ B, y} = EC_{PJ, ECDG, y} \times \frac{FC_{ECDG, D, y} \times NCV_{D, y} \times EF_{CO2, D, y}}{EG_{ECDG, y}} \quad \textbf{(3)}$$

Where:

$PE_{EC, Scenario\ B, y}$ = Project emissions from electricity consumption in year y (tCO_2/yr)

$EC_{PJ, ECDG, y}$ = Quantity of electricity consumed from the Emergency Captive Diesel Generator (ECDG) in year *y* (MWh/yr)

$FC_{ECDG, D, y}$ = Quantity of Diesel fired in the Emergency Captive Diesel Generator (ECDG) in the time period *t* (mass or volume unit)

$NCV_{D, y}$ = Average net calorific value of the Diesel used in the period *t* (GJ/mass or volume unit)

$EF_{EJ, j, y}$ = Emission factor for the Diesel in year *y* (tCO_2/MWh)

$EG_{ECDG, y}$ = Electricity Generated by the Emergency Captive Diesel Generator (ECDG) in the time period *t* (MWh)

As the all electricity produced by the Emergency Captive Diesel Generator is used only to supply the project,

$EC_{PJ, ECDG, y} = EG_{ECDG, y}$

And the equation is updated to:

$$PE_{EC, Scenario\ B, y} = FC_{ECDG, D, y} \times NCV_{D, y} \times EF_{CO2, D, y} \quad \textbf{(4)}$$

Project emissions from electricity consumption are equal to:

$$PE_{EC, y} = PE_{EC, Scenario\ B, y} \quad \textbf{(5)}$$

As the project does not consume any kind of fossil fuel, total project emissions are equal to:

$$PE_{y} = PE_{EC, y} \quad \textbf{(6)}$$

c) Leakage

According with*version 11 of ACM0001*, no leakage needs to be accounted.

d) Emission Reductions

Emission Reductions will be calculated according with the equation below:

$$ER_y = BE_y - PE_y \quad \textbf{(7)}$$

Where:

ER_y = Emission Reductions 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 as per equation 8 (tCO_2e)

PE_y = Project Emissions from electricity consumption from the grid and from the captive diesel generator in year *y* (tCO_2e);

Even though the flares were in operation during the monitoring period, the flare monitoring system was not in accordance with the monitoring plan, hence PP decided to disregard all the CERs from burning in flares. For the next monitoring period it will be followed step by step the Tool to determine project emissions from flaring gases containing methane.

It was created a Spreadsheet called "BLFGE_18th_Verification_Calculation Spreadsheet, which contains the values mentioned in the table below. This spreadsheet will be attached to Monitoring Report.

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

Total Methane Destroyed in Flares (Nm^3), measured by FIR200 and FIR700	**-**
Total Methane destroyed in the Power House (Nm^3), measured by FIR300, FIR400, FIR500,FIR600 and FIR100 only 01/05/2013[12]	**33,394,653**
Total Electricity Exported, measured at Bandeirantes Landfill's substation (MWh)	**87,860.5497**

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. Biogas applies the bigger one between maximum accuracy limit and the maximum error found in the calibration certificates
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 flow meters, according to the approved monitoring plan.
The errors for each instrument 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:

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

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

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

[12] To be more conservative, on 01/05/2011 the value of FIR 100 (102,589) was used.

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

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

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

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:

$$\varepsilon_{FIR200} = \sqrt{1.000^2 + 0.6471^2 + 0.2^2 + 1.000^2} = 1.5681\%$$

$$\varepsilon_{FIR700} = \sqrt{2.500^2 + 1.000^2} = 2.6926\ \%$$

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:

Error applied :

$$\varepsilon_{FIR300} = \sqrt{1.0000^2 + 0.5993^2 + 0.2^2 + 1.0000^2} = 1.5490\%$$

$$\varepsilon_{FIR400} = \sqrt{1.0000^2 + 0.1775^2 + 0.2^2 + 1.0000^2} = 1.4393\%$$

$$\varepsilon_{FIR500} = \sqrt{1.0000^2 + 0.8717^2 + 0.2^2 + 1.0000^2} = 1.6733\%$$

$$\varepsilon_{FIR600} = \sqrt{1.000^2 + 0.1998^2 + 0.2^2 + 1.0000^2} = 1.4422\%$$

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. As Biogás Energia Ambiental SA does not have installed a volume meter in emergency diesel generator according to the monitoring plan, for this monitoring period, it was considered the maximum consumption of the diesel in one hour of operation of the diesel emergency generator. This value was calculated by the maximum diesel consume during one hour (44 L/h). This consume value was provided by the operation manual. When the generator starts, it will register in PLC a complete hour, even if it worked only a few minutes. So we consider that the generator produced 0,125 MW/h (by the operation manual). To calculate diesel consume, is multiplied the worked hours by the maximum consume.

$$PE_{EC,} = FC \times NCV_{D,y} \times EF_{CO2,D}$$

For this monitoring period:

FC= 9,988.00 L
$NCV_{D,y}$ = 0,050 GJ/L
$EF_{CO2,D}$= 0,0741 tCO2/GJ
.: $PE_{EC,}$ = 38 tCO2

Please, refer to "BLFGE_18th_Verification_Calculation Spreadsheet" in worksheet "Consolidated_EN".

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:

$\mathbf{ER_y}$ = Emission reductions in year $_y$
$\mathbf{BE_y}$ = Baseline emissions in year $_y$
$\mathbf{PE_y}$ = 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 avoided 413,233 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	413,271	38	-	413,233

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: 413,233 tCO_2.

According to the registered PDD, the estimated value of emission reduction is 576,358 tCO_2e, that is 932.62 tCO_2e per day (365 days per year), while the project activity actually generates totally 413,233 tCO2e emission reductions during this monitoring period – from 23/12/2010 to 31/08/2012 – with 618 days for the monitoring period. That is about 668.6618 tCO2e per day, which is 28.3% 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. 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)	413,233

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

Not Applicable

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO2e)	**413,233**	**-**

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History of the document

Version	Date	Nature of revision
0.3.2	5 November 2013	Editorial revision to correct table in page 1.
0.3.1	2 January 2013	Editorial revision to correct table in section E.5.
0.3.0	EB 70, Annex 11 3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards.
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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