

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

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MONITORING REPORT

Version 01 – 24/11/2010

Salvador da Bahia Landfill Gas Management Project

Project 0052

Fourth Monitoring Period: 01/01/2007 – 31/12/2007

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

The Salvador da Bahia Landfill Gas Management Project encompasses capturing and flaring landfill gas (LFG) at the Aterro Metropolitano Centro (AMC) landfill. LFG is generated due to anaerobic decomposition of the MSW disposed in the landfill. Under the project scenario, all collected LFG is combusted in high efficiency enclosed flares, thus reducing emissions of CH₄ that would otherwise be emitted the atmosphere.

The project has been operated by BATTRE (Bahia Transferência e Tratamento de Resíduos Ltda.) a special purpose company that was created to undertake services of collections and disposal of Municipal Solid Waste (MSW) in the city of Salvador, Bahia in Brazil. BATTRE works under the directives of a service concession contract signed within the administration of the municipality of Salvador.

The installed LFG collection system consists of a series of vertical extraction wells and horizontal trenches interconnected through a high density polyethylene pipeline. LFG is thus extracted from the landfill with the use of blowers and conducted to a main pipe for being sent to the flares. As required by AM0002 methodology, the amount and quality of the collected LFG which is sent to the flares is continuously measured: volume of LFG (determined on the basis of continuous LFG flow measurement), CH₄ content of LFG, temperature of LFG and pressure of LFG.

All collected LFG is sent to 3 enclosed flares for combustion (one of the existing three enclosed flares has not been under operation). The temperatures of the exhaust gases of these 3 operating enclosed flares are also monitored. All the monitoring instruments and analyzer are installed in the main LFG pipeline and measurements data are electronically recorded and stored in a computer in the control room.

The project activity was implemented in the *Aterro Metropolitano Centro de Salvador* (AMC) as per the Project Design Document (PDD) version 5 of March 2005 and the Monitoring and Verification Plan v3 of October 2003 and in accordance to the AM0002 methodology. The project was validated in February 2003 (as per the Validation Report issued by the DOE Det Norske Veritas Certification A.S. (DNV) of number 2003-1598 version 3 issued in January 2004). A Letter of Approval (LoA) for the project activity was issued by the DNA of Brazil on 2nd June, 2004. The project was registered as a CDM project activity on August 15th, 2005. The project activity started to operate in March 2004. It is noteworthy that the Salvador da Bahia Landfill Gas Management Project was one of the first projects comprising LFG collection and destruction registered as a CDM project activity worldwide.

Total GHG emissions reductions achieved in this monitoring period are:

Monitoring Period	Emission Reductions(tCO ₂ e)
01/01/2007 – 31/12/2007	491,959
TOTAL	491,959

A.2. Project Participants

Project Participants	Name of Parties involved
Bahia Transferência e Tratamento de Resíduos S.A. (Project developer)	Brazil
Showa Shell Sekiyu K.K.	Japan
Shell Trading International Limited	United Kingdom of Great Britain and Northern Ireland
Electrabel S.A	Netherlands

A.3. Location of the project activity:

Salvador, Bahia, Brazil

Cia. Aeroporto, Road, km 6.5

Geographical location: 12°51'45"S and 38°21'59"W

The AMC landfill is located in a rural area of Salvador, approximately 20 km North-East of the city center region.

A.4. Technical description of the project

Apart of receiving all collected MSW from Salvador (a city with about 3,000,000 inhabitants), the AMC landfill also receives MSW from two other cities in the neighbouring area (Simões Filho and Lauro de Freitas). Although the total area of the landfill is 2,500,000 m², the area currently reserved for disposal of MSW is 600,000 m². The landfill has a total disposal capacity of 20,000,000 m³ and receives approximately 850,000 tonnes of MSW per year. The average organic content of the disposed MSW is approximately 60%.

The following pictures are from the project activity.



Figure 1 : View of the LFG collection and destruction station
(equipped with 3 enclosed flares of which 2 have been under operation)



Figure 2: View of the landfill area where LFG collecting wells are installed

The LFG collection system consists of a series of vertical wells and horizontal trenches which are interconnected through a high density polyethylene (HDPE) pipeline. The wells and trenches extract LFG from inside the landfill up to the top of the surface. Captured LFG is transported to the LFG destruction station through the HDPE pipeline. In the LFG destruction station the following equipment/instruments are installed:

- 1 Condensate trap that separate liquid (leachate and condensate) from LFG;
- 3 Blowers that provide negative pressure in the LFG pipeline;
- 1 set of LFG Monitoring equipment/instruments: LFG flow, LFG temperature, LFG pressure, LFG CH₄ content, temperature in the exhaust gases of the flares.
- 3 operating enclosed flares with nominal capacity of 6,000 m³ each and temperature operation range of 500°-1200°C.

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

The *Salvador da Bahia Landfill Gas Management Project* applies the approved large scale methodology AM0002 – Greenhouse gas emission reductions through landfill gas capture and flaring where the baseline is established by a public concession contract - version 01.

A.6. Registration date of the project activity:

15/08/2005

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

7-year renewable crediting period from 01/01/2004 to 31/12/2010. No changes to the start date of the crediting period post-registration have occurred.

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

Contact information of technical staff members of BATTRE which were responsible for completing the monitoring report form (CDM-MR):

Mr. Lucas Radel – Focal Point – lradel@solvi.com

Mr. Mark Zulauf – CDM Consultant - markzulauf@gmail.com

Phone +55 71 3239-8714

CIA Airport Road, km 6,5 – Salvador, BA, Brazil

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

The operating starting date of the project activity is 12/03/2004.

The existing LFG collection and destruction station runs 24 hours per day. During the monitoring period from 1 January 2007 to 31 December 2007 the project activity operated with 3 flares, 3 blowers, 1 condensate pot and more than 200 LFG extracting wells which were connected to 4 main HDPE pipes that transport all collected LFG from the landfill area to the LFG destruction station.

During the verification period from 1 January 2007 to 31 December 2007, as described in the PDD, all collected LFG was sent to destruction in the 3 operating enclosed flares. No collected LFG was utilized as fuel or energy source for any purpose (electricity generation, bottled or inserted in a natural gas distribution pipeline, etc.)

All electricity consumed by the project activity has been sourced by the National Interconnected Electricity Grid of Brazil. The project was designed with all electricity consumption being measured with an electricity meter. It is however noteworthy that the installed electricity meter did not operate properly during the verification period from 1 January 2007 to 31 December 2007.

Thus, as a conservative measure to determine the emissions associated with grid electricity consumption (accounted as leakage emissions as per AM0002), the nameplate installed power of the 3 blowers + an assumed 10 kW (as the needed power for the administration facility incl. office equipment such as air conditioner, lighting, computers, etc...) were used as a basis for the estimation of electricity consumption by the project activity during the verification period as follows:

It was assumed that the 24-hour operation a day during the whole monitoring period of the three blowers + an assumed 10 kW of office equipments have consumed a total of 1,892 MWh (206 kW+10kW (administration) multiplied by 24x365 hours/year) during the whole one year verification period: name plate power of the blowers: 125 HP (94 kW), 75 HP (56 kW) and 75 HP (56 kW).

Potential measuring deviations/errors for LFG flow and methane content of captured LFG are acknowledged due to delays in the calibration of instruments used to monitor LFG flow, LFG pressure and LFG temperature as well as due to the delays and results of the calibration of the CH₄ content gas analyzer. Such non-compliance within the relevant instrument/equipment calibration requirements as per the monitoring plan were considered in the determination of the amount of methane which was destroyed by the flares in a conservative way.

While such potential measuring deviations/errors and delays (as per the calibration frequency established in the Monitoring Plan) were both identified during the calibration events valid for the LFG flow meter and CH₄ gas analyzer, by following the “Guidelines for assessing compliance with the calibration frequency requirements”, deduction factors were applied in the accumulated values of amount of methane destroyed by the flare during affected selected time periods in a conservative manner.

It is also noteworthy that it was also identified non-compliance within the calibration frequency requirements for the LFG temperature sensor and for LFG pressure sensor during the monitoring period.

By also applying the “Guidelines for assessing compliance with the calibration frequency requirements”, deduction factors were also defined and applied in measurement values for these sensors in a conservative manner.

The application of all defined conservative deduction factors is demonstrated in the emission reduction calculation spreadsheet which is enclosed to the Monitoring Report.

Monitoring of Sustainable Development (SD) Indicator:

As indicated in the PDD, SD indicators are also monitored as established in Battre's procedure PAF 012.

Capital Expenditures with local social and environmental programs:

During the initial design phase of the project activity, BATTRE has assumed a commitment to voluntarily allocate 5% of the net carbon revenues (from the sale of issued CERs) within local social and environmental programs or within activities that would benefit the local community, environment and local economy in general. While, such capital expenditures were initially planned to occur only after issuance and commercialization of the CERs, BATTRE has already voluntarily spent R\$ 72,849.70 (USD 43,000) by sponsoring of specific projects and initiatives.

Economic Development Indicators

- The accumulated incremental direct employment indicator (new jobs generated by the project activity): 21 (20 new employees at BATTRE and 1 external consultant that work exclusively with the project activity).
- The salary indicator confirmed that, apart of generating employment opportunities, the LFG collection and destruction project at Salvador da Bahia landfill also promotes salaries which are higher when compared to the average salary for employees at the Landfill and the Residue Transfer Station. Moreover, the project activity requires higher qualification for involved staff, this triggering training and competence development requirements.
- Income generation index (calculated according to BATTRE's specific methodology):
 - Landfilling operations: 5.78
 - Operations of the waste transfer station: 6.49
 - LFG collection and destruction project: 9.44

Environmental and Social Development Indicators:

- The waste density was calculated based on the landfill topographic assessments reaching 1.1329 ton/m³.
- Reforestation activities have been included in the Landfill Environmental Management Plan. Reforestation areas were selected where priority was given to the Riparian Forests. The reforestation activities performed in 2007 achieved 1.73 ha of covered area according to the issued report..
- The "Estação das Formas" Program, which aimed to promote environmental education and awareness related to the waste management activities carried out by BATTRE to about 2,016 children.
- Complaints regarding odour (odour level classified as strong or medium) according to visitors' registries + CAC Support Center + interviews regularly conducted correspond to 39% of total odour related comments. From years 2003 and 2005 the corresponding values were 41, 36%, 30% and 50%.

- With regard to safety, there were 2 notified and registered accidents with dismissal in year 2007. The accident frequency indicator is 12.14 (number of accidents per 1 million worked hours) and the gravity indicator is 0.46 (day per 1 million worked hours). Both indicators are below the company targets.
- The air pollution indicator data is annually evaluated with a set of sampling analyses, performed by CEPED (Centro de Pesquisa e Desenvolvimento). The analyzed parameters continued to register ND values (not detectable) or under the equipment low detection level.
- The leachate infiltration indicator is 59%. From years 2003 to 200 the corresponding values are 39.8%, 49.8%, 50.1% and 40.4% respectively.

Technology Transfer Indicators:

- Transfer of technology has been performed via seminars organized/sponsored/joined by BATTRE.

B.2. Revision of the monitoring plan

No revision of monitoring plan was applied.

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

No deviation of the monitoring plan was applied.

B.4. Notification or request of approval of changes

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

SECTION C. Description of the monitoring system

According to the monitoring plan of the registered PDD, all monitoring data (LFG flow, LFG pressure, LFG temperature, methane content of LFG, temperature of the exhaust gases of the flares) are continuously measured by related instruments/equipment.

The figures below show the installation of some of the monitoring instruments:

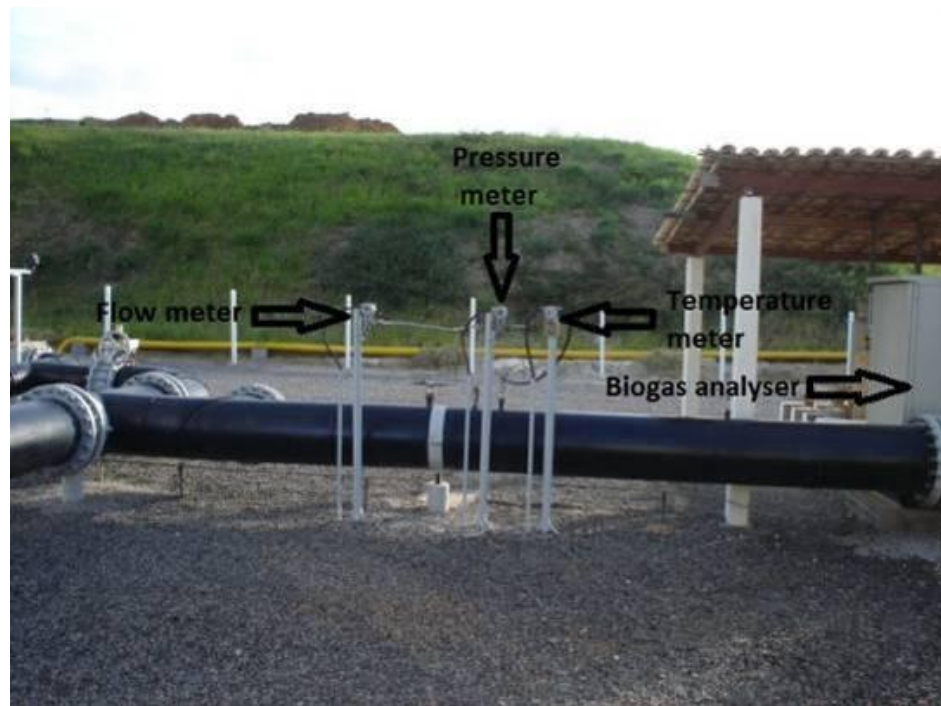


Figure 3: Location of the LFG flow meter, LFG pressure sensor, LFG pressure sensor and the CH₄ content gas analyzer

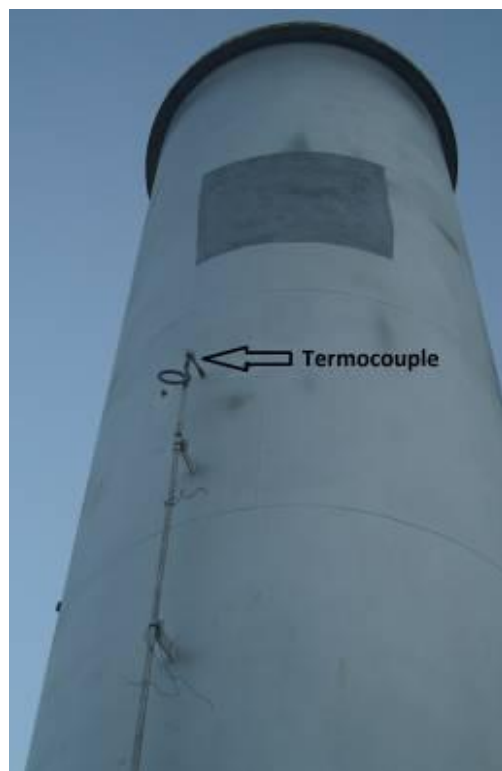


Figure 4 – Location of the thermocouple used to measure temperature of the exhaust gas of the flare (1 thermocouple for each flare)



Figure 5 – Panel of the CH₄ gas analyzer unit

Continuous measurements of LFG flow, LFG temperature, LFG pressure, CH₄ content of collected LFG and temperature of the exhaust gas of the flares are processed by Programmable Logic Controlled Unit (PLC) and are recorded every 20 seconds in a mainframe computer.

In order to calculate GHG emission reductions, recorded monitoring data is exported from the mainframe computer to a local computer where a MS-Excel spreadsheet is automatically generated. As part of the data export procedure, a MS Access data base also updated. The data export procedure is performed every hour.

All information from the MS-Access based database is also regularly archived in back-up CDs. Data from the mainframe is also backed-up regularly.



Figure 6 - Screen with real time information of the LFG destruction station

Electricity consumption by the project activity is measured with a Kron (model MKM-D) electricity meter.



Figure 7 – View of the electricity meter Kron MKM-D

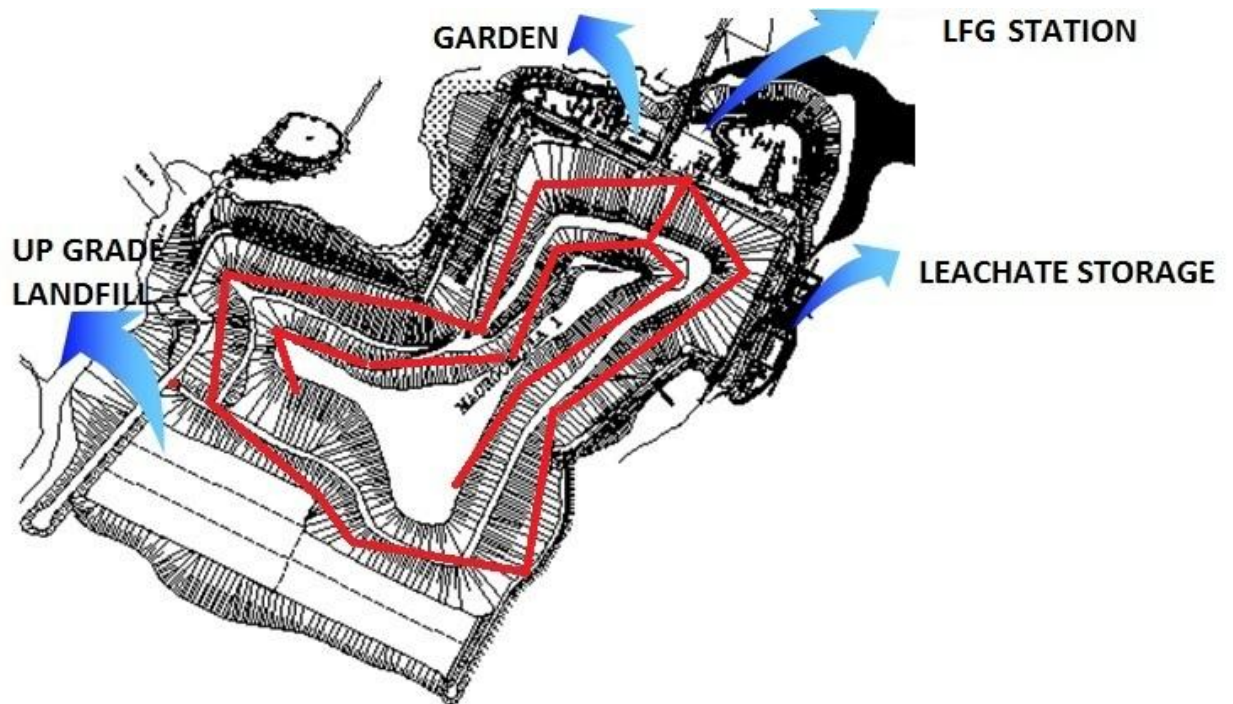


Figure 8 – Lay-Out from the Landfill, infrastructure and LFG pipes (in red)

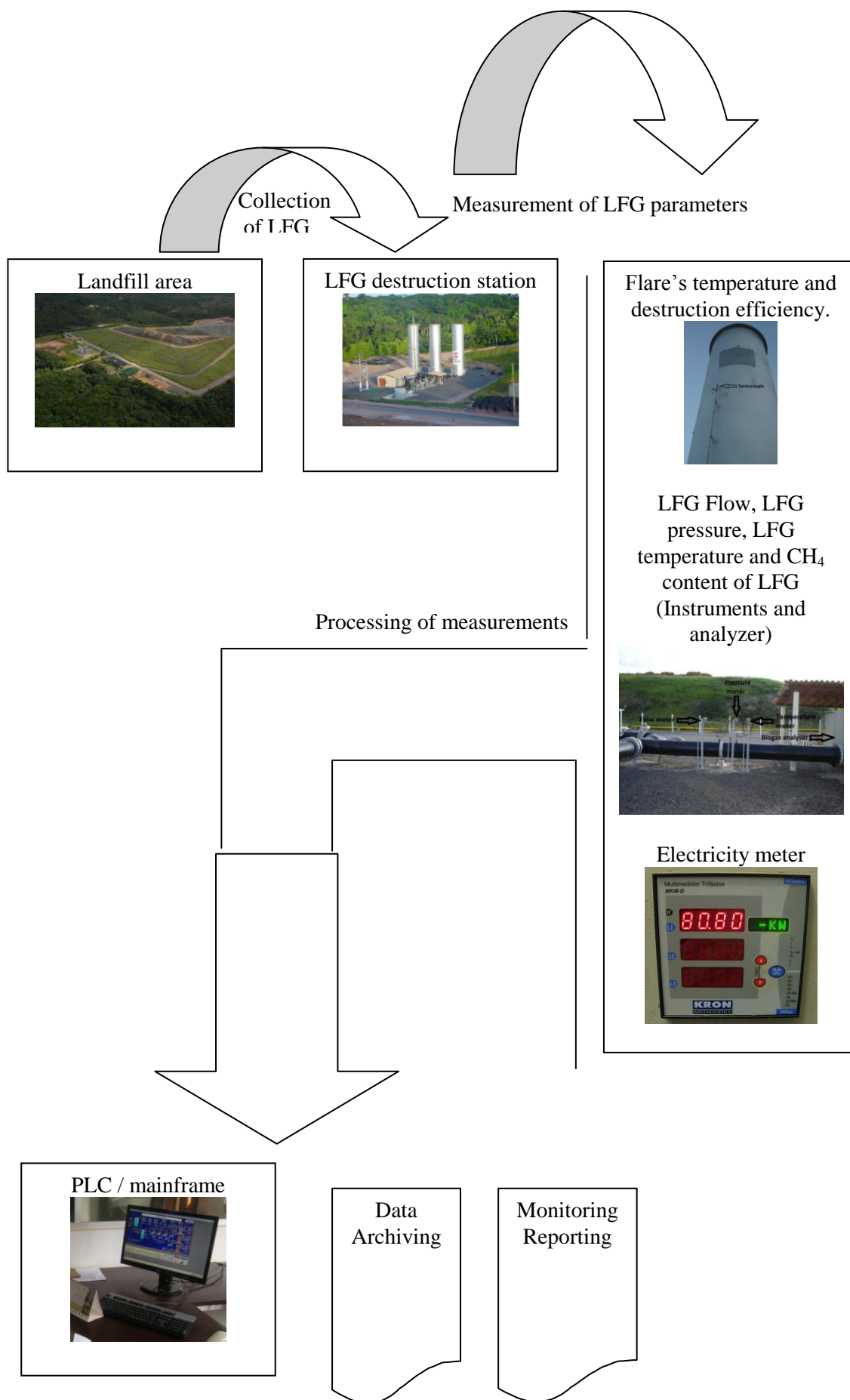


Figure 9 – Monitoring data, information processing and archiving flow

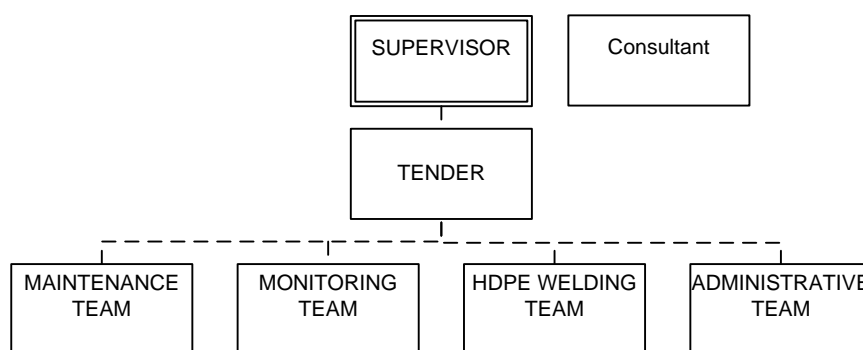


Figure 10 – Organizational structure for the project activity

Responsibilities and Roles:

As per the implemented organizational structure the technical project staff of BATTRE has the followed responsibilities:

Consultant: Responsible for the monitoring report and general LFG process coordination.

Supervisor: Supervise the LFG collections and destruction process.

Tender: Operate the LFG station, storage data's and calibrations procedures and coordinate the maintenance, monitoring, welding and administrative team.

Maintenance team: Responsible for the field maintenance and upgrade the LFG collection system.

Monitoring team: Responsible for the wellhead monitoring/regulations and field report.

HDPE welding team: Responsible for the HDPE welding and pipes slope adjustments.

Administrative team: responsible for operational internal reports and equipment calibrations.

Quality Assurance and Quality Control:

The LFG project (internally named as “biogas system”) has been inserted in the scope of the BATTRE ISO 9001 and 14001 certified QA/QC/ EMS systems in 2004. The quality assurance and environmental certification scopes for the operation of the LFG project were thus audited and approved by ABS at December 23rd, 2005. All quality assurance and quality control measures as per the Monitoring Plan of the PDD have been systematically followed by the project operational team.

Emergency procedures for the monitoring system:

Battre has created and implemented a set of precautions, safety and emergency procedures to ensure that the monitoring process do not failed. The operation of the monitoring system is performed on the basis of equipment and instruments which have spare units. Moreover, the project operational staff works in shifts thus assuring 24 hour support to the project activity.

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

Data / Parameter:	CF
Data unit:	tCH ₄ / m ³ CH ₄ STP
Description:	Conversion factor (density)
Source of data used:	AM0002 version 01 default value
Value(s) :	0.000662
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	

Data / Parameter:	CH ₄ GWP
Data unit:	tCO ₂ e/ tCH ₄
Description:	Global Warming Potential (GWP) of Methane
Source of data used:	IPCC Second Assessment Report , 1995
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	This default value is valid for the first commitment period of Kyoto Protocol (31/12/2012).

Data / Parameter:	Waste _{contract,y}
Data unit:	ton
Description:	Quantity of waste projected to be disposed at the landfill as per contract
Source of data used:	Reference value for the contractual agreement signed between BATTRE and the administration of the municipality of Salvador.
Value(s) :	910,000
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	

Data / Parameter:	CH ₄ /LFG _{contract}
Data unit:	Nm ³ CH ₄ / Nm ³ LFG
Description:	Considered methane content of landfill gas for the determination of value of CH _{4,contract,y}
Source of data used:	AM0002 version 01 default value
Value(s) :	50%
Indicate what the data are	Baseline emissions calculations

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

Data / Parameter:	COEF _{LPG}
Data unit:	tCO ₂ / ton
Description:	LPG emission factor
Source of data used:	IPCC 2006 volume 2 chapter 2 (t CO ₂ /TJ) and Brazilian Energetic Balance (TJ/ton)
Value(s) :	2.93
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations due to consumption of LPG by the project activity.
Additional comment:	Emission factor of 63.1 tCO ₂ /TJ and NCV of 0.0465 TJ/ton

Data / Parameter:	NCV _{LPG}
Data unit:	TJ/ton
Description:	Net Calorific Value from LPG
Source of data used:	Brazilian Energetic Balance, 2006
Value(s) :	0.0465
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations due to consumption of LPG by the project activity.
Additional comment:	

Data / Parameter:	EF _{LPG}
Data unit:	tCO ₂ /TJ
Description:	Emissions factor for LPG
Source of data used:	IPCC 2006 volume 2 chapter 2
Value(s) :	63.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations due to consumption of LPG by the project activity.
Additional comment:	According to “Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion”.

Data / Parameter:	TDL
Data unit:	%
Description:	Transitions and Distributions Losses
Source of data used:	Default value as per the “Tool to calculate baseline, project and/or

	leakage emissions from electricity consumption”
Value(s) :	20%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage calculations due to consumption of electricity by the project activity.
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	Waste _{actual}
Data unit:	ton
Description:	Monitored quantity of waste actually disposed at the landfill
Measured /Calculated /Default:	Measured by 2 weight bridge scales
Source of data:	Monitored at the entrance of the landfill by weight bridge scales.
Value(s) of monitored parameter:	875,044
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Weight Bridge Scale Manufacturer: Toledo do Brasil Indústria de Balanças Ltda. Model:810 and 8530Accuracy: 0.1% Serial number: 98790028 and 3500011350 BATTRE internal id reference: BAL 01 and BAL 02 Calibration frequency: Annually Calibration dates: BAL 01 - 17/12/2006 and 25/05/2007 BAL 02 - 18/12/2006 and 25/05/2007
Measuring/ Reading/ Recording frequency:	Every truck transporting MSW to be disposed in the landfill is weighted and the data is directly measured by the administration of the municipality of Salvador and recorded by a SPA Software (Waste Scale Landfill Production System) consolidated daily.
Calculation method (if applicable):	
QA/QC procedures applied:	The equipments are calibrated annually and the data collection procedures are implemented as per company's ISO 9001 and 14001 certified quality and environmental management system.

Data / Parameter:	CH _{4,flared,y}
Data unit:	CH ₄ Nm ³
Description:	Monitored quantity of methane sent to flare, that is calculated by the PLC and mainframe on the basis of measurement records of LFG flow (converted to standard conditions using LFG temperature and LFG pressure records) and CH ₄ content.

Measured /Calculated /Default:	Related measurements are performed by LFG flow meter, CH ₄ /O ₂ content gas analyzer unit , LFG pressure sensor and LFG temperature sensor. The quantity of methane sent to the flares is calculated by the PLC (programmable logic computer) on the basis of performed measurements.
Source of data:	Monitored by instruments/equipments installed in the main LFG pipeline before the flares
Value(s) of monitored parameter:	37,248,140 Nm ³ CH ₄
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<p><i>LFG flow:</i></p> <p>Type: LD301 Flow meter (annubar with a Differential Pressure Transmitter - PDT)</p> <p>Manufacturer: SMAR Equipamentos Ind. Ltda.</p> <p>Accuracy: 0.075%</p> <p>Serial number:</p> <p>FT001- u205518</p> <p>FT002 – u299430</p> <p>BATTRE internal id reference: FT001 and FT002</p> <p>Calibration frequency: yearly</p> <p>Calibration date:</p> <p>FT 001 - not calibrated this year</p> <p>FT 002- 15/06/2007</p> <p><i>LFG Pressure:</i></p> <p>Type: LD301 Pressure meter</p> <p>Manufacturer: SMAR Equipamentos Ind. Ltda.</p> <p>Accuracy: 0.075%</p> <p>Serial number:</p> <p>PT001 – u193241</p> <p>PT002 - u194121</p> <p>BATTRE internal id reference: PT001 and PT002</p> <p>Calibration frequency: yearly</p> <p>Calibration date:</p> <p>PT 001 - 15/06/2007</p> <p>PT 002- not calibrated this year</p> <p><i>LFG Temperature:</i></p> <p>Type: TT301 Temperature Transmeter</p> <p>Manufacturer: SMAR Equipamentos Ind. Ltda.</p> <p>Accuracy: 2%</p> <p>Serial number:</p> <p>TT001- 30938</p> <p>TT002- 30937</p> <p>BATTRE internal id reference: TT001 and TT002</p> <p>Calibration frequency: yearly</p> <p>Calibration date:</p> <p>TT 001 – 08/06/2006 and 28/09/2007</p> <p>TT 002 - 08/06/2006 and 28/09/2007</p>

	<p>Manufacturer: IOPE</p> <p>Type: PT100</p> <p>Accuracy: 2%</p> <p>Serial number: TE001- 36195, TE002 - NC</p> <p>BATTRE internal id reference: TE001 and TE002</p> <p>Calibration frequency: yearly</p> <p>Calibration date:</p> <p>TE 001 – 30/05/2006 and 02/08/2007</p> <p>TE 002 - not calibrated this year</p>
Measuring/ Reading/ Recording frequency:	The PLC receives measurement signals of LFG Flow, LFG Pressure, LFG Temperature and CH ₄ content of LFG as input data and processes related calculations and data recording. Continuously measurements are recorded every 20 seconds.
Calculation method (if applicable):	According to ISO 9001 certified QA/QC procedure PTO 034.
QA/QC procedures applied:	The equipments are calibrated annually and the data collection procedures are implemented as per company's ISO 9001 and 14001 certified quality and environmental management system.

Data / Parameter:	CH _{4,contract,y}
Data unit:	Nm ³ CH ₄
Description:	Quantity of methane required to be flared regardless of the project activity as per contractual requirements established by the Administration of the municipality of Salvador.
Measured /Calculated /Default:	Defined by the administration of the municipality of Salvador as per previously set contractual agreement.
Source of data:	Contractual agreement between BATTRE and the administration of the municipality of Salvador. A communication was officially issued by the administration of the municipality of Salvador confirming the values applicable for the years 2005-2010
Value(s) of monitored parameter:	1,890,050 Nm ³ CH ₄
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The value for every year is defined by the administration of the municipality of Salvador based on the amount of waste actually disposed in the landfill and or projections.
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	As stated in the official communication issued by the administration of the municipality of Salvador confirming the values applicable for the

	<p>years 2005-2010.</p> <p>The values were defined by the administration of the municipality of Salvador, by taking into account technical information made available in an official study/evaluation published by Companhia Ambiental do Estado de São Paulo (CETESB) (Environmental Agency for São Paulo State in Brazil). This study encompassed an analytical analysis of emissions of methane from passive flare systems from 35 landfills in Brazil (including the AMC landfill in Salvador) and has served as a technical basis for the definition of the value of the parameter $CH_{4,contract,y}$ by the administration of the municipality of Salvador for years 2005, 2006, 2007, 2008, 2009 and 2010.</p>
QA/QC procedures applied:	

Data / Parameter:	CH ₄ /LFG _{actual}			
Data unit:	Nm ³ CH ₄ / Nm ³ LFG			
Description:	Actual methane content in the captured LFG			
Measured /Calculated /Default:	Measured by a installed infrared CH ₄ /O ₂ content gas analyzer			
Source of data:	Monitored by equipment installed in the main LFG pipeline before the flares.			
Value(s) of monitored parameter:	Measured values ranged from 36.9% to 47.6% (Daily and monthly average under normal operational conditions) during the verification period.			
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations			
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Infrared CH ₄ /O ₂ content gas analyzer			
	Manufacturer: Fisher Rosemount - Rosemount Analytical			
	Model: MLT1TIRIPO2			
	Accuracy: 1%			
	Serial number: 30011429704			
	BATTRE internal id reference: AI001			
	Calibration frequency: every 2 weeks			
	Calibration date:			
	02/01/07	16/04/07	30/07/07	29/10/07
	09/01/07	23/04/07	07/08/07	05/11/07
	16/01/07	30/04/07	09/08/07	12/11/07
	24/01/07	07/05/07	14/08/07	19/11/07
	29/01/07	14/05/07	20/08/07	26/11/07
	06/02/07	21/05/07	27/08/07	03/12/07
	12/02/07	28/05/07	03/09/07	10/12/07
19/02/07	04/06/07	10/09/07	14/12/07	
26/02/07	13/06/07	17/09/07	17/12/07	
05/03/07	19/06/07	20/09/07	22/12/07	
13/03/07	25/06/07	24/09/07	24/12/07	
19/03/07	02/07/07	01/10/07	31/12/07	
26/03/07	09/07/07	08/10/07		
02/04/07	16/07/07	15/10/07		

	09/04/07	23/07/07	22/10/07		
Measuring/ Reading/ Recording frequency:	Continuously measured with recording frequency of 20 seconds.				
Calculation method (if applicable):	Methane content in the captured LFG is measured with an infrared CH ₄ content gas analyzer unit. Measured data is consolidated daily as per ISO9001 certified QA/QC's working procedure/instruction number PTO 034.				
QA/QC procedures applied:	The equipments are calibrated annually and the data collection procedures are implemented as per company's ISO 9001 and 14001 certified quality and environmental management system.				

Data / Parameter:	EC _{grid}
Data unit:	MWh
Description:	Amount of grid electricity consumed by the project activity.
Measured /Calculated /Default:	Calculated
Source of data:	Monitored
Value(s) of monitored parameter:	1,892 MWh (equivalent of 3 blowers + 10kW from the administration power hypothetical consumption).
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Type: Electricity meter Manufacturer: Kron Instrumentos Elétricos Ltda. Model: MKM-D Accuracy: 0,2% Serial number: ME001 - 866987 ME002 - 919600 BATTRE internal id reference: ME001 e ME002 Calibration frequency: yearly Calibration date: ME001 - 26/06/2006 and 04/10/2007 ME002 - 26/05/2006
Measuring/ Reading/ Recording frequency:	Yearly
Calculation method (if applicable):	Due to technical problems in the installed electricity meters, the amount of grid electricity consumed by the project activity was estimated on the basis of installed power capacity from 3 blowers is 206 kW+10kW (administration) multiplied by 24x365 hours/year.
QA/QC procedures applied:	

Data / Parameter:	EF _{grid,CM}
Data unit:	tCO ₂ /MWh
Description:	Grid CO ₂ emission factor
Measured /Calculated /Default:	Calculated
Source of data:	DNA of Brazil
Value(s) of monitored parameter:	0.1842
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions calculations due to grid electricity consumption
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Calculation results are made publicly available by the Brazilian DNA (http://www.mct.gov.br/index.php/content/view/303073.html)
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	
QA/QC procedures applied:	

Data / Parameter:	FC _{LPG}
Data unit:	ton
Description:	Amount of fossil fuel (LPG) consumed by the project activity
Measured /Calculated /Default:	Measured
Source of data:	Monitored on basis of LPG purchasing records from Battre.
Value(s) of monitored parameter:	0.19 ton
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Leakage emissions calculations due to consumption of fossil fuel by the project activity.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The quantity of LPG consumed is calculated by taking into account the total amount of LPG purchased during the period as registered in the BATTRE Management System.
Measuring/ Reading/ Recording frequency:	LPG is only consumed for lighting the flares (flare pilots). Apart of the project activity there is no other demand for LPG in the AMC landfill.
Calculation method (if applicable):	
QA/QC procedures applied:	

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

Data / Parameter:	FE
Data unit:	%
Description:	Methane destruction efficiency
Measured /Calculated /Default:	Measured by a third part company
Source of data:	ERM do Brasil
Value(s) of monitored parameter:	99.9636
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	As per information available in the analysis reports, the measurements were performed by the company ERM do Brasil using an analyzer FID / California Analytical Instruments (CAI), model 300 M
Measuring/ Reading/ Recording frequency:	Measurement frequency: 4 time per year. The lowest value of the flare efficiency as per conducted sample measurements/tests of residual methane in the exhaust gases of the flares tests was adopted.
Calculation method (if applicable):	
QA/QC procedures applied:	

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

As established by the registered PDD and also in accordance with AM0002, emission reductions (ER_y) are calculated as follows:

$$ER_y = ER_{CH_4,y} * CF * GWP_{CH_4} - Leakage$$

Where:

ER_y Amount of GHG emission reduction measured (in tCO_2e)
 CF Conversion factor density (default value of $0.000662 \text{ tCH}_4 / \text{CH}_4 \text{ m}^3 \text{ STP}$)
 GWP_{CH_4} Global Warming Potential (GWP) of methane (default value of $21 \text{ tCO}_2e / \text{tCH}_4$)
 $Leakage$ The leakage emission sources are consumption of grid electricity and consumption of fossil fuel by the project activity.

$ER_{CH_4,y}$ Methane emission reduction (in $\text{CH}_4 \text{ m}^3 \text{ STP}$), where:

$$ER_{CH_4,y} = CH_{4,flared,y} * FE - CH_{4,baseline,y}$$

Where:

FE_y Flare efficiency
 $CH_{4,flared,y}$ Quantity of methane actually flared (in $\text{CH}_4 \text{ Nm}^3$)
 $CH_{4,baseline,y}$ Quantity of methane that would be flared in baseline (in $\text{CH}_4 \text{ Nm}^3$). The determination of $CH_{4,baseline,y}$ takes into account eventual differences of waste disposed and methane content as

per contractual requirements and values actually monitored as follows:

$$CH_{4,baseline,y} = CH_{4,contract,y} * Waste_{actual,y} / Waste_{contract,y} * (CH_4/LFG_{actual}) / (CH_4/LFG_{contract})$$

Where:

$CH_{4,contract,y}$	Quantity of methane to be flared regardless of the project activity as per contractual requirements (in Nm ³ CH ₄)
$Waste_{actual,y}$	Quantity of waste actual disposed at the landfill (in ton)
$Waste_{contract,y}$	Reference quantity of waste projected to be disposed at the AMC landfill as per contractual requirements (in ton)
CH_4/LFG_{actual}	Annual calculated average methane content in landfill gas (in Nm ³ CH ₄ / Nm ³ LFG)
$CH_4/LFG_{contract}$	Daily average methane content in landfill gas as per contractual requirements (in Nm ³ CH ₄ / Nm ³ LFG)

All these formulas are inserted in the “Salvador da Bahia spreadsheet” which is an emission reduction calculation spreadsheet which is internally used as a basis for the emission reduction calculations.

It is important to note that as per both the registered PDD and AM0002 (version 1) methodology, FE_y (flare efficiency) is not required to be taken into account for the determination of ER_CH_{4,y}. Anyhow, for sake of completeness, the total volume of methane collected and destroyed in the flares (CH₄_{flared}) is multiplied by the lowest value of the flare efficiency as per conducted sample measurements/tests (determined on the basis of 4 sample analysis/tests of residual methane in the exhaust gases of the flares (4 sample basis measurement/tests were performed during year 2007 by the company ERM do Brasil).

The table below presents a summary of performed measurements of methane content of flare exhaust gas.

The flare destruction efficiency range was determined based on conducted measurements/tests of amount of residual methane in the exhaust gases of the flares by an independent third part (ERM do Brasil). Results of the performed measurements are as follow:

1° Measurement

Results: 99.9970%-99.9676%

2° Measurement

Results: 100%-99.9636%

3° Measurement:

Results: 100%-99.9978%

4° Measurement:

Results: 99.9989%-99.9957%

Methane Efficiency Destruction Factor / Flare efficiency (FE) = 0.999636

The lower value resulted from the performed flare efficiency tests was used.

Date	Entity / Company in charge of the measurement	Lowest results of the 4 measurements
2007	ERM do Brasil	0.999636

E.2. Project emissions calculation

Not applicable. It is important to note that as per AM0002 methodology, emissions due to the consumption of grid electricity and consumption of LPG (for starting up the flares) are regarded as leakage emissions.

Moreover, residual methane emissions due to the efficiency of the enclosed flares are considered in the context of the baseline emission calculations.

E.3. Leakage calculation

As per both the registered PDD and AM0002 version 1, accounting associated GHG emissions due to consumption of grid electricity and fossil fuel by the project activity is not a requirement for the calculation of the achieved emissions reductions.

Anyhow, for sake of correctness and completeness, such emissions sources were also taken into account for the emission reduction calculations as follow:

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

$$PE_{FC} = FC_{LPG} * COEF_{LPG}$$

Where:

PE_{FC} Emissions due to fossil fuel (LPG) consumption by the project activity

FC_{LPG} Amount of fossil fuel (LPG) consumed by the project activity: monitored as 0.19 ton

$COEF_{LPG}$ Conversion emissions factor for fossil fuel (LPG). The Emission factor for LPG ($COEF_{LPG}$) is selected as 2.93 tCO₂e/ton LPG

$$PE_{FC} = FC_{LPG,2007} * COEF_{LPG} = 0.19 \text{ ton} * 2.93 \text{ tCO}_2\text{e/ton LPG} = 0.5 \text{ tCO}_2\text{e} = 1 \text{ tCO}_2$$

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

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

Where:

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

EC_{grid} Amount of electricity consumed by the grid in the project activity: monitored as 1,892 MWh

TDL	Total distribution losses. The default 20% value is adopted.
EF _{grid,CM}	Combined margin emissions factor for grid electricity. The Emission Factor of Brazilian Interconnected National Electricity Grid is calculated as the average of the Build Margin (BM) and Operating Margin (OM) of the Brazilian Grid for each year. Data is available online at: http://www.mct.gov.br/index.php/content/view/303073.html

Emission Factor ₂₀₀₇ (tCO ₂ /MWh)		
Build Margin	Operating Margin	Combined Margin
0.0775	0.2909	0.1842

Emission Factor of Brazilian Grid (EF_{grid,CM,2005}) = 0.1842 tCO₂e/MWh

$$LE_{EC,2007} = EC_{grid,2007} * EF_{grid,CM,2007} * (1+20\%) = 0.1842 \text{ tCO}_2\text{e/MWh} * 1,892 \text{ MWh} * 1.2 = 418 \text{ tCO}_2\text{e}$$

Summary of Leakage emissions:

Item	tCO ₂
PE _{FC2007}	1
LE _{EC2007}	418
Total leakage (tCO₂e)	419

E.4. Emission reductions calculation / table

Total baseline emissions:	492,378
Total project emissions:	0
Total leakage:	419
Total emission reductions:	491,959

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

The emission reductions were *ex-ante* estimated in the PDD as 716,442tCO₂e for year 2007. Emission reductions are reported as 491,959 tCO₂e for the monitoring period from 1 January 2007 to 31 December 2007. Reported emissions are thus 31% lower than *ex-ante* estimated emission reductions.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO₂e)	716,442	491,959

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

No increase in the actual emission reductions achieved during the monitoring period from 1 January 2007 to 31 December 2007 has occurred when compared with the *ex-ante* estimation of emission reductions in the PDD for the same time period (year 2007).

By considering all the potential uncertainties associated with the First Order Decay (FOD) multi-phased model used for the *ex-ante* estimation of emission reductions in the PDD, and also taking into account aspects associated with the operation and performance of a typical LFG collection and destruction project activity, the ~31% difference between the achieved emission reductions and the PDD's *ex-ante* estimation of emission reductions for year 2007 are regarded as acceptable.