

Imagine the Result

Bandeirantes Landfill Gas to Energy Project (BLFGE)

Monitoring Report – Version 01
5th Verification
Monitoring Period: 01/07/2007 to 31/10/2007

São Paulo, November 7th, 2007



Clean Development Mechanism

Monitoring Report – Version 01

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Monitoring Period: 01/07/2007 to 31/10/2007

Biogás Energia Ambiental SA

São Paulo
November 7th, 2007

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Glossary

CDM	Clean Development Mechanism
CDM-EB	Clean Development Mechanism Executive Board
PDD	Project Design Document
CER	Certified Emission Reduction
GHG	Greenhouse Gas
GWP	Global Warming Potential
CH ₄	Methane
EF	Grid CO ₂ Electricity Emission Factor

1. General Project Activity and Monitoring Information

1.1. Title and Registration Number of the Project Activity

Bandeirantes Landfill Gas to Energy Project (BLFGE), Registration Number 0164

1.2. Short Description of the Project Activity:

Bandeirantes Landfill Gas to Energy Project (BLFGE) is a project designed to explore the landfill gas produced in Bandeirantes landfill, one of the biggest landfills in Brazil. This landfill is located in the metropolitan region of São Paulo, Brazil's biggest city and financial center of the country. With an estimated population of around 10 million citizens in 2000, São Paulo generates nearly 15.000 tons of waste daily. Bandeirantes Landfill Gas to Energy Project (BLFGE)'s goal is to explore the gas produced in Bandeirantes landfill, using it to generate electricity.

1.3. Real Project Implementation

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



Figure 1.1. Bandeirantes Landfill Cells

The degassing stations are responsible for extracting the landfill gas from the landfill and transport it to the gas engines in the power plant. During the transportation, the gas goes through a treatment to allow its use as fuel for energy generation. Other functions of the

degassing stations are: drying landfill gas by gas coolers; and measuring and analyzing the quantity and quality of the landfill gas for safety, process and operating purposes.



Figure 1.2. Degassing Station (A) and Power Plant (B)

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

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

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



Figure 1.3. Compressors (blue) and dryers (metal)

On the pressure side of the degassing station, all kinds of gas analyzing and gas measuring instruments are present. These instruments are very important for safety, process and operating purposes. After the described treatment, analyzing and measurement, the landfill gas is transported as a fuel to the gas engines. These drive electrical generators in order to generate electrical power. An occasional surplus of the landfill gas can be burned off by the flares.



Figure 1.4. Turbine Flow-meter



Figure 1.5. Generators used to produce electricity



Figure 1.6. Flare used to destroy the surplus gas collected

The whole process is controlled by an electrical control system. This control system is provided with a PLC (Programmable Logical Controller). 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 1.7. PLC Controlling System panel

For electricity generation, a total of 24 Caterpillar engines, nominal capacity of 925 kW, model 3516 A were installed. They will burn the gas and generate energy, which is to be sent to Eletropaulo's – the electric distributor supplying São Paulo metropolitan region – grid. This electricity will in fact not be commercialized directly; it will supply Unibanco's branches over São Paulo state.

1.4. Changes against the PDD

The changes made against the registered PDD are:

- Installation of 4 new flow-meters to measure the gas flow to the power house;
- periodical monitoring of methane content in the exhaust flare gas, made by a specialized company on gas analysis;
- changes in the gas station's lay-out. This change was necessary in order to adapt the gas station to treat an increase of landfill gas collected (average 17.000 Nm³/h) – changes were presented in the Monitoring Report from the 4th Verification.

1.5. Monitoring Period

The monitoring period is from 01/07/2007 to 31/10/2007.

1.6. Methodology applied to the project activity

1.6.1. Baseline methodology

The baseline applied to this project activity is **ACM0001 – version 2: “Consolidated baseline methodology for landfill gas project activities”**.

1.6.2. Monitoring methodology

The monitoring methodology applied to this project activity is **ACM0001 – version 2: “Consolidated monitoring methodology for landfill gas project activities”**.

1.7. Changes since last verification

No major changes were identified since the last verification.

1.8. Person(s) responsible for the preparation and submission of the monitoring report

This monitoring report was developed and reviewed by:



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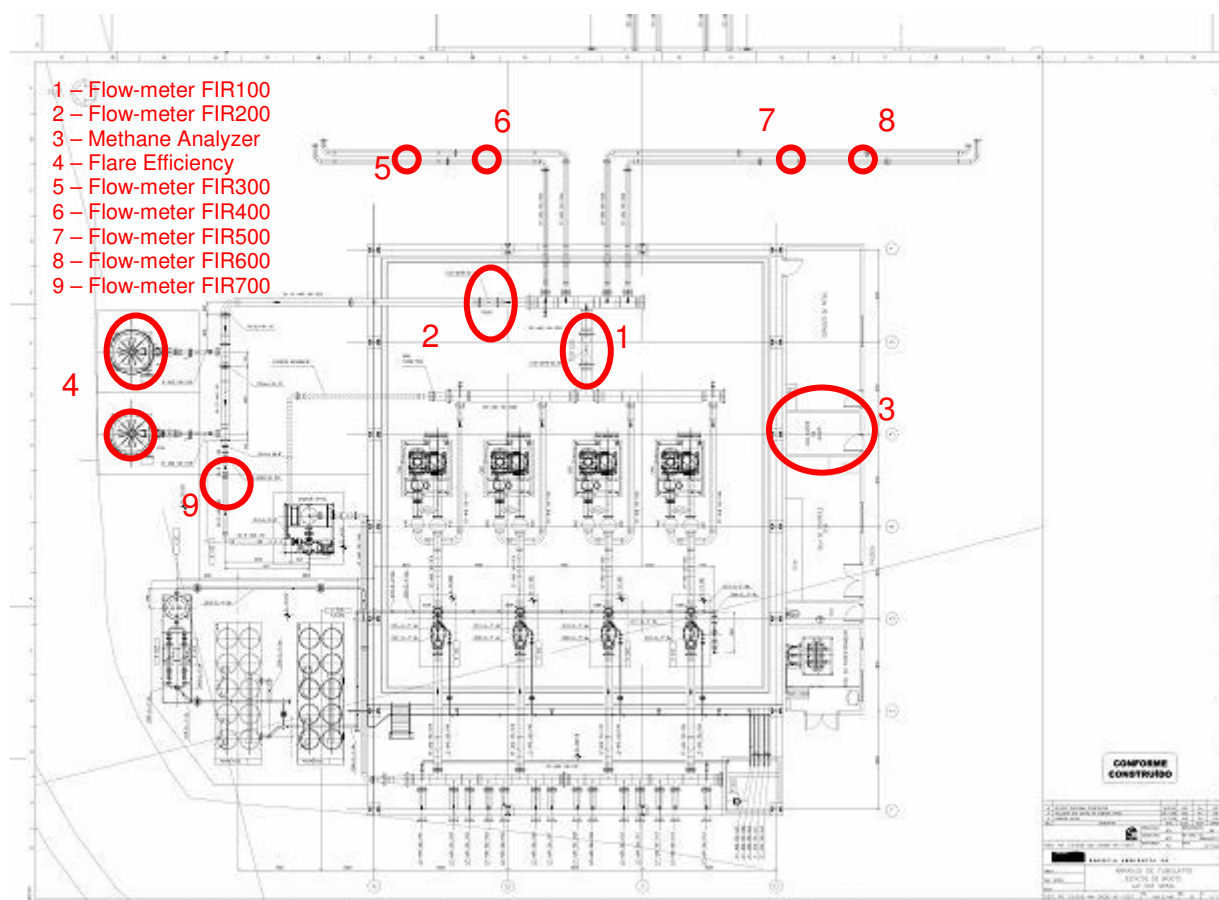


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2. Key monitoring activities according to the monitoring plan

2.1. Monitoring equipment

The following equipment are used to monitor the operation of the project and to monitor the Emission Reduction



1 – Flow-meter FIR100 (Gas Collected in the main pipeline)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Flow Meter	Instromet	SM-RI X K	0,600
Temperature	Temperature Transmitter	Instromet	model 333-H	0,100
Pressure	Pressure Transmitter	Instromet	model 333-H	0,100

2 – Flow-meter FIR200 (Gas sent to Flare F100)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
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Gas Flow	Flow Meter	Instromet	SM-RI X K	0,600
Temperature	Temperature Transmitter	Instromet	model 333-H	0,100
Pressure	Pressure Transmitter	Instromet	model 333-H	0,100

3 – Methane Analyzer

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Methane Analyzer	Analyzer Panel	NUK	BINOS 100	1,000

4 – Exhaust Gas Methane Concentration

Analysis made by specialized company.

5 – Flow-meter FIR300 (Gas sent to the Power House)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Flow Meter	Instromet	SM-RI X K	0,7720
Temperature	Temperature Transmitter	Instromet	model 333-H	0,0500
Pressure	Pressure Transmitter	Instromet	model 333-H	0,0337

6 – Flow-meter FIR400 (Gas sent to the Power House)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Flow Meter	Instromet	SM-RI X K	0,5960
Temperature	Temperature Transmitter	Instromet	model 333-H	0,0500
Pressure	Pressure Transmitter	Instromet	model 333-H	0,0381

7 – Flow-meter FIR500 (Gas sent to the Power House)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Flow Meter	Instromet	SM-RI X K	0,8100
Temperature	Temperature Transmitter	Instromet	model 333	0,0500
Pressure	Pressure Transmitter	Instromet	model 333	0,3700

8 – Flow-meter FIR600 (Gas sent to the Power House)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Flow Meter	Instromet	SM-RI X K	0,6320
Temperature	Temperature Transmitter	Instromet	model 333-H	0,0500
Pressure	Pressure Transmitter	Instromet	model 333-H	0,4440

9 – Flow-meter FIR700 (Gas sent to Flare F200)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
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Gas Flow	Flow Meter	TZ	G 1600	0,3300
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2.1.1.1. Power House

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Electricity Dispatched	Electricity Meter	Merlin Gerin	0011001426 - CM 4000 0011001414 - CM 4000	0,04

2.1.2. Involvement of Third Parties

BFLGE has two third parties involved:

- Specialized company on gas analysis: As the analysis of methane concentration in the exhaust gas is made periodically, Biogás hired TASQA and BIOAGRI, two national and certified laboratories.
- Sotreq: Sotreq is the company that produces the electricity in ICEs, using the gas from the landfill. Sotreq is responsible to monitor the electricity displaced to the local grid. The amount of electricity dispatched is monitored by Sotreq's PLC and by Biogás's PLC.

2.2. Data collection (accumulated data for the monitoring period)

2.2.1. List of fixed default values

Global Warming Potential of CH_4 (GWP_{CH_4}) = 21 tCO₂e/tCH₄;

Emission Factor of the S-SE-CO Brazilian Grid (EF) = 0,2677 tCO₂e/MWh;

Density of Methane, at STP (D_{CH_4}) = 0,0007168 tons/m³

2.2.2. List of variables

$Q_{biogas, collected}$ = amount of biogas collected from the landfill (Nm³)

$Q_{biogas, flares}$ = amount of biogas sent to flares (Nm³)

$Q_{biogas, power house}$ = amount of biogas sent to the power house (Nm³)

% $_{CH_4}$ = percentage of methane in the biogas (% volume);

EG_y = amount of electricity dispatched to the grid (MWh);

FE = Flare Efficiency (calculated using data from methane sent to flares and methane content in the exhaust gas);

AF = Adjustment Factor (changes in the landfill legislation). For this monitoring period, no changes in the legislation were identified, thus the AF remains as the validated value (20%).

2.2.3. Data concerning GHG emissions of the project activity

As BLFGE does not consume electricity that are not taken account in the Net Electricity value, $PE_y = 0$.

2.2.4. Data concerning GHG emissions of the baseline

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm ³)	Methane (%)	Methane Collected (Nm ³)	Methane FIR200 (Nm ³)	F100 Efficiency (%)	Methane Destroyed (Nm ³)	LFG Collected (Nm ³)	Methane FIR700 (Nm ³)	F200 Efficiency (%)	Methne Destroyed (Nm ³)	Methane FIR300 (Nm ³)	Methane FIR400 (Nm ³)	Methane FIR500 (Nm ³)	Methane FIR600 (Nm ³)	Electricity Exported (MWh)
01/07/2007	278.605	51,0093	142.114,4602	13.287,4125	99,99998	13.287,4098	48.794	24.889,4778	99,99998	24.889,4728	28.938,5960	33.953,8304	28.685,5899	34.779,1609	396,9188
02/07/2007	285.795	51,3340	146.710,0053	21.353,9173	99,99998	21.353,9130	48.022	24.651,6134	99,99998	24.651,6084	27.616,6653	34.265,4450	23.678,3208	39.715,0624	392,1799
03/07/2007	296.168	49,7690	147.399,8519	11.295,5722	99,99998	11.295,5699	46.788	23.285,9197	99,99998	23.285,9150	29.377,1476	30.500,9316	38.505,2799	35.877,9744	427,8857
04/07/2007	295.301	50,0621	147.833,8819	11.287,5016	99,99998	11.287,4993	38.392	19.219,8414	99,99998	19.219,8375	29.554,6613	30.730,6200	38.639,4306	36.203,9094	422,8095
05/07/2007	245.984	52,0006	127.913,1559	16.944,9155	99,99998	16.944,9121	47.605	24.754,8856	99,99998	24.754,8806	29.629,9418	32.993,3406	40.969,7127	33.456,1460	340,9520
06/07/2007	221.111	52,6100	116.326,4971	22.550,7504	99,99998	22.550,7458	46.239	24.326,3379	99,99998	24.326,3330	15.230,5950	25.656,3187	26.638,0213	25.305,9361	290,9216
07/07/2007	298.288	49,6479	148.093,7279	11.678,1790	99,99998	11.678,1766	41.963	20.833,7482	99,99998	20.833,7440	25.066,2317	34.378,1918	39.047,5768	37.651,9744	435,2187
08/07/2007	295.192	49,4857	146.077,8275	16.597,5037	99,99998	16.597,5003	41.959	20.763,7048	99,99998	20.763,7006	28.749,2122	33.586,9343	33.252,9058	32.274,0786	411,2198
09/07/2007	296.231	49,2753	145.968,7139	13.302,8527	99,99998	13.302,8500	42.014	20.702,5245	99,99998	20.702,5203	28.883,7026	33.153,4073	32.817,3498	36.320,8236	420,6695
10/07/2007	212.922	52,5847	111.964,3949	13.878,6798	99,99998	13.878,6770	42.465	22.330,0928	99,99998	22.330,0883	24.654,3365	31.198,5025	22.298,5420	23.568,4625	313,0836
11/07/2007	294.472	50,1281	147.613,2186	14.550,1823	99,99998	14.550,1793	37.569	18.832,6258	99,99998	18.832,6220	32.911,6040	34.355,7946	32.374,2308	31.175,6679	413,1546
12/07/2007	269.919	51,1624	138.097,0384	12.310,6966	99,99998	12.310,6941	33.384	17.080,0556	99,99998	17.080,0521	31.480,2247	27.224,0246	28.830,5240	36.848,1837	380,5113
13/07/2007	290.348	49,4059	143.449,0425	10.868,8039	99,99998	10.868,8017	46.139	22.795,3882	99,99998	22.795,3836	33.181,0024	24.652,0619	33.875,1553	40.336,9529	414,0318
14/07/2007	294.114	49,1954	144.690,5587	13.519,8798	99,99998	13.519,8770	37.242	18.321,3508	99,99998	18.321,3471	31.697,5801	27.577,9573	31.024,0951	39.546,7061	411,9950
15/07/2007	303.176	49,2513	149.318,1212	14.277,4593	99,99998	14.277,4564	26.329	12.967,3747	99,99998	12.967,3721	30.922,9212	34.643,8569	33.555,8957	34.833,9669	421,9350
16/07/2007	306.588	49,7034	152.384,6599	14.533,2741	99,99998	14.533,2711	31.221	15.517,8985	99,99998	15.517,8953	34.849,0418	29.066,0512	33.927,0438	39.338,2529	431,9678
17/07/2007	263.307	51,6326	135.952,2500	20.015,8937	99,99998	20.015,8896	44.625	23.041,0477	99,99998	23.041,0430	30.778,7091	32.692,7296	25.860,1877	23.805,7265	359,2914
18/07/2007	249.341	55,2343	137.721,7559	28.853,2936	99,99998	28.853,2878	43.394	23.968,3721	99,99998	23.968,3673	28.319,7302	32.998,0755	19.151,9411	25.653,5706	324,7000
19/07/2007	267.652	52,1166	139.491,1222	26.050,4825	99,99998	26.050,4772	29.613	15.433,2887	99,99998	15.433,2856	30.093,6883	30.021,2462	21.914,5091	29.471,4161	348,9900
20/07/2007	321.247	50,4440	162.049,8366	31.057,8663	99,99998	31.057,8600	47.474	23.947,7845	99,99998	23.947,7797	33.825,7286	33.604,2794	27.549,4861	33.835,8174	408,1000
21/07/2007	347.710	50,2364	174.676,9864	40.945,6801	99,99998	40.945,6719	0	0,0000	99,99998	0,0000	35.029,3393	32.609,4519	27.023,1642	36.885,0719	416,6400

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm³)	Methane (%)	Methane Collected (Nm³)	Methane FIR200 (Nm³)	F100 Efficiency (%)	Methane Destroyed (Nm³)	LFG Collected (Nm³)	Methane FIR700 (Nm³)	F200 Efficiency (%)	Methane Destroyed (Nm³)	Methane FIR300 (Nm³)	Methane FIR400 (Nm³)	Methane FIR500 (Nm³)	Methane FIR600 (Nm³)	Electricity Exported (MWh)
22/07/2007	321.322	51,3020	164.844,6124	43.203,4662	99,99998	43.203,4575	0	0,0000	99,99998	0,0000	29.648,9648	30.176,3494	28.891,7473	34.456,9883	382,9600
23/07/2007	330.192	51,4885	170.010,9079	43.165,8988	99,99998	43.165,8901	0	0,0000	99,99998	0,0000	26.011,4753	32.098,4457	31.953,2482	36.188,1773	395,2500
24/07/2007	335.572	50,9704	171.042,3906	34.005,9217	99,99998	34.005,9148	0	0,0000	99,99998	0,0000	33.948,8349	32.552,2459	34.455,9904	34.830,6228	429,4700
25/07/2007	317.122	50,8562	161.276,1985	28.088,8963	99,99998	28.088,8906	16.572	8.427,8894	99,99998	8.427,8877	35.352,1788	28.995,1538	34.235,3767	33.297,5883	419,9400
26/07/2007	315.856	50,1732	158.475,0625	21.936,2247	99,99998	21.936,2203	36.642	18.384,4639	99,99998	18.384,4602	35.117,2261	32.031,5743	33.949,1940	33.063,6370	427,0200
27/07/2007	297.089	51,0739	151.734,9387	23.035,8611	99,99998	23.035,8564	43.986	22.465,3656	99,99998	22.465,3611	33.003,9541	32.643,3724	29.466,0651	31.184,7018	395,2200
28/07/2007	261.990	52,7864	138.295,0893	24.032,5921	99,99998	24.032,5872	45.744	24.146,6108	99,99998	24.146,6059	29.634,8128	31.955,3029	20.770,9205	27.812,0984	341,2600
29/07/2007	303.771	50,5770	153.638,2586	22.616,0113	99,99998	22.616,0067	49.869	25.222,2441	99,99998	25.222,2390	29.336,1773	35.428,1769	28.132,4447	34.992,7089	400,5100
30/07/2007	262.839	52,4618	137.890,0705	23.934,6470	99,99998	23.934,6422	45.642	23.944,6147	99,99998	23.944,6099	26.235,6215	33.288,5859	24.976,5383	26.468,0273	342,3400
31/07/2007	299.130	51,6666	154.550,3005	24.530,2683	99,99998	24.530,2633	47.719	24.654,7848	99,99998	24.654,7798	29.354,3787	34.546,8720	30.177,4277	33.995,5894	399,8900
01/08/2007	308.333	50,5190	155.766,7482	24.399,6666	99,99998	24.399,6617	46.835	23.660,5736	99,99998	23.660,5688	33.862,8857	33.999,7921	27.602,5712	33.542,5952	408,6700
02/08/2007	301.563	51,0090	153.824,2706	25.303,5245	99,99998	25.303,5194	47.565	24.262,4308	99,99998	24.262,4259	28.771,6264	31.674,0385	32.747,2679	33.619,5218	397,4900
03/08/2007	308.488	50,3871	155.438,1570	20.532,2393	99,99998	20.532,2351	44.361	22.352,2214	99,99998	22.352,2169	34.278,3441	29.110,6431	35.231,6680	34.680,4331	421,2500
04/08/2007	302.011	50,5684	152.722,1305	23.960,8249	99,99998	23.960,8201	47.348	23.943,1260	99,99998	23.943,1212	35.131,8902	30.396,1595	26.314,7839	34.673,2348	400,5000
05/08/2007	307.724	49,7541	153.105,3066	19.002,0858	99,99998	19.002,0819	47.959	23.861,5688	99,99998	23.861,5640	35.272,1741	29.348,9485	33.208,8715	34.539,2962	417,3400
06/08/2007	304.676	50,0291	152.426,6607	12.647,3564	99,99998	12.647,3538	47.273	23.650,2564	99,99998	23.650,2516	34.978,8458	28.993,3643	39.613,0413	34.860,2768	436,1800
07/08/2007	300.327	49,8621	149.749,3490	19.047,3222	99,99998	19.047,3183	46.955	23.412,7490	99,99998	23.412,7443	33.756,6417	28.049,9243	36.647,6462	30.724,5273	409,0200
08/08/2007	289.359	49,8784	144.327,6394	13.034,2234	99,99998	13.034,2207	47.420	23.652,3372	99,99998	23.652,3324	34.268,9547	26.147,2548	36.486,5483	33.103,2965	410,8600
09/08/2007	292.466	50,2378	146.928,4841	9.946,5820	99,99998	9.946,5800	42.816	21.509,8164	99,99998	21.509,8120	34.458,6093	31.622,6855	34.768,0742	34.175,7705	428,8200
10/08/2007	294.218	50,2413	147.818,9480	15.090,9792	99,99998	15.090,9761	42.816	21.511,3150	99,99998	21.511,3106	32.385,0395	34.006,8287	30.034,7515	34.178,1515	417,0600
11/08/2007	286.548	50,7246	145.350,3268	13.035,2077	99,99998	13.035,2050	44.773	22.710,9251	99,99998	22.710,9205	34.983,2348	34.631,2061	27.434,3999	32.528,6714	410,6900
12/08/2007	295.022	49,9413	147.337,8220	9.199,1874	99,99998	9.199,1855	47.620	23.782,0470	99,99998	23.782,0422	33.526,5935	34.603,8273	34.909,9675	32.450,8579	432,8200

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm³)	Methane (%)	Methane Collected (Nm³)	Methane FIR200 (Nm³)	F100 Efficiency (%)	Methane Destroyed (Nm³)	LFG Collected (Nm³)	Methane FIR700 (Nm³)	F200 Efficiency (%)	Methne Destroyed (Nm³)	Methane FIR300 (Nm³)	Methane FIR400 (Nm³)	Methane FIR500 (Nm³)	Methane FIR600 (Nm³)	Electricity Exported (MWh)
13/08/2007	290.489	50,0958	145.522,7884	10.133,3784	99,99998	10.133,3763	45.468	22.777,5583	99,99998	22.777,5537	34.915,2697	34.454,8893	33.255,5958	30.135,6294	424,9300
14/08/2007	288.424	50,4809	145.599,0310	17.545,1416	99,99998	17.545,1380	46.253	23.348,9306	99,99998	23.348,9259	32.550,0843	34.576,3876	25.386,8446	32.813,5946	398,9600
15/08/2007	294.057	50,0153	147.073,4907	18.926,2896	99,99998	18.926,2858	46.988	23.501,1891	99,99998	23.501,1843	30.607,3629	33.543,7612	28.294,1553	33.567,2684	400,1900
16/08/2007	262.114	51,8368	135.871,5099	17.438,4178	99,99998	17.438,4143	48.944	25.371,0033	99,99998	25.370,9982	29.609,1801	30.001,5847	29.346,8859	27.389,5283	358,3400
17/08/2007	295.845	49,7726	147.249,7484	20.537,6679	99,99998	20.537,6637	48.590	24.184,5063	99,99998	24.184,5014	33.573,1118	25.726,4614	37.636,5469	28.549,0656	394,3400
18/08/2007	291.917	49,8868	145.628,0499	20.693,5435	99,99998	20.693,5393	47.063	23.478,2246	99,99998	23.478,2199	31.632,7210	25.796,9631	38.998,0081	27.495,1098	388,1600
19/08/2007	289.068	49,5105	143.119,0121	13.757,9777	99,99998	13.757,9749	47.458	23.496,6930	99,99998	23.496,6883	27.589,7261	29.970,1909	40.084,1959	33.536,9273	411,9400
20/08/2007	293.868	49,1506	144.437,8852	14.654,2513	99,99998	14.654,2483	47.401	23.297,8759	99,99998	23.297,8712	28.212,9359	28.751,1349	38.629,9140	33.586,0794	407,5500
21/08/2007	288.158	49,4565	142.512,8612	12.641,0814	99,99998	12.641,0788	48.550	24.011,1307	99,99998	24.011,1258	30.213,4704	28.461,7211	36.800,5816	33.465,2352	405,1500
22/08/2007	286.275	49,8767	142.784,5229	7.647,5944	99,99998	7.647,5928	45.757	22.822,0816	99,99998	22.822,0770	34.077,7565	28.206,2713	38.580,1262	33.096,1830	423,2000
23/08/2007	286.059	49,6243	141.954,7763	12.449,7443	99,99998	12.449,7418	45.011	22.336,3936	99,99998	22.336,3891	31.350,1515	28.091,8199	36.125,9941	33.720,2080	406,0300
24/08/2007	287.027	49,2895	141.474,1731	12.433,7692	99,99998	12.433,7667	45.960	22.653,4542	99,99998	22.653,4496	27.463,6165	27.610,4992	37.303,2793	36.822,2138	407,0600
25/08/2007	271.016	49,8357	135.062,7207	13.800,5020	99,99998	13.800,4992	45.668	22.758,9674	99,99998	22.758,9628	28.336,0806	24.605,8785	35.755,6196	32.692,2192	378,9300
26/08/2007	286.859	49,6743	142.495,2002	21.004,7777	99,99998	21.004,7734	38.565	19.156,8937	99,99998	19.156,8898	30.647,5528	18.169,8654	37.400,7739	35.874,7794	381,4900
27/08/2007	286.984	49,0649	140.808,4126	13.221,0279	99,99998	13.221,0252	43.889	21.534,0939	99,99998	21.534,0895	32.647,2938	21.428,1137	34.867,4805	39.197,9486	402,9100
28/08/2007	295.314	49,1979	145.288,2864	18.381,8113	99,99998	18.381,8076	48.222	23.724,2113	99,99998	23.724,2065	29.332,2799	23.859,0135	37.441,5698	35.414,6163	393,1500
29/08/2007	299.493	49,3583	147.824,6534	12.823,7799	99,99998	12.823,7773	46.639	23.020,2175	99,99998	23.020,2128	27.805,9983	28.075,9882	38.451,5964	39.648,0416	417,6600
30/08/2007	301.456	49,7534	149.984,6095	13.560,7867	99,99998	13.560,7839	45.112	22.444,7538	99,99998	22.444,7493	29.767,9567	27.080,2780	40.122,6343	38.546,9441	422,6200
31/08/2007	293.968	49,8847	146.645,0548	18.231,8601	99,99998	18.231,8564	47.002	23.446,8066	99,99998	23.446,8019	29.939,7992	27.206,1176	40.320,3064	38.736,9660	398,4800
01/09/2007	290.333	49,9972	145.158,3706	16.258,0894	99,99998	16.258,0861	47.361	23.679,1738	99,99998	23.679,1690	30.870,2711	24.798,6112	38.088,8669	33.869,6031	401,0100
02/09/2007	291.491	49,6072	144.600,5233	15.914,4858	99,99998	15.914,4826	41.174	20.425,2685	99,99998	20.425,2644	34.174,4000	22.868,9192	36.646,3268	33.582,0901	400,3400
03/09/2007	268.021	50,9461	136.546,2466	16.982,8824	99,99998	16.982,8790	52.483	26.738,0416	99,99998	26.738,0362	30.786,2187	23.995,1036	32.724,2084	30.368,9702	365,0900

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm ³)	Methane (%)	Methane Collected (Nm ³)	Methane FIR200 (Nm ³)	F100 Efficiency (%)	Methane Destroyed (Nm ³)	LFG Collected (Nm ³)	Methane FIR700 (Nm ³)	F200 Efficiency (%)	Methane Destroyed (Nm ³)	Methane FIR300 (Nm ³)	Methane FIR400 (Nm ³)	Methane FIR500 (Nm ³)	Methane FIR600 (Nm ³)	Electricity Exported (MWh)
04/09/2007	273.067	52,0489	142.128,3697	24.187,1238	99,99998	24.187,1189	39.373	20.493,2133	99,99998	20.493,2092	30.339,3038	24.719,5840	28.277,1263	32.600,8285	358,9800
05/09/2007	295.213	50,6333	149.476,0839	21.882,6995	99,99998	21.882,6951	36.863	18.664,9533	99,99998	18.664,9495	32.263,5387	27.727,3014	33.065,0638	32.574,9335	395,5700
06/09/2007	299.146	50,1725	150.089,0268	19.004,3395	99,99998	19.004,3356	39.496	19.816,1306	99,99998	19.816,1266	29.752,2925	28.168,3466	39.047,2498	32.760,1338	408,8800
07/09/2007	300.681	49,8246	149.813,1055	19.466,9694	99,99998	19.466,9655	38.842	19.352,8711	99,99998	19.352,8672	30.998,8731	27.342,2457	39.627,9956	33.640,0751	405,8100
08/09/2007	300.165	49,5121	148.617,9949	17.404,4933	99,99998	17.404,4898	38.033	18.830,9369	99,99998	18.830,9331	30.629,6704	27.446,0423	39.377,9633	31.578,3222	406,6400
09/09/2007	299.994	49,3180	147.951,0409	16.403,6599	99,99998	16.403,6566	40.063	19.758,2703	99,99998	19.758,2663	30.695,5232	27.071,6365	39.616,6562	33.317,7612	410,0000
10/09/2007	299.487	49,0791	146.985,5242	14.888,6357	99,99998	14.888,6327	42.056	20.640,7062	99,99998	20.640,7020	33.284,9548	26.140,5102	37.517,5364	33.868,9961	412,9900
11/09/2007	294.627	49,2550	145.118,5288	13.740,1748	99,99998	13.740,1720	42.638	21.001,3469	99,99998	21.001,3426	28.946,6709	29.787,9463	37.918,9617	33.702,2412	411,8900
12/09/2007	294.075	49,1791	144.623,4383	9.779,7558	99,99998	9.779,7538	44.797	22.030,7614	99,99998	22.030,7569	28.922,7205	31.307,9068	39.830,1530	33.521,4581	422,1100
13/09/2007	292.406	49,3536	144.312,8876	10.725,0308	99,99998	10.725,0286	43.700	21.567,5232	99,99998	21.567,5188	31.284,7535	30.930,3946	38.289,5099	31.811,3564	419,2600
14/09/2007	285.861	49,5824	141.736,7444	11.865,5641	99,99998	11.865,5617	46.239	22.926,4059	99,99998	22.926,4013	32.682,2389	29.338,4019	36.986,4871	29.752,9107	406,7500
15/09/2007	286.510	49,6763	142.327,5671	7.822,0301	99,99998	7.822,0285	46.450	23.074,6413	99,99998	23.074,6366	30.774,9646	33.597,0752	35.143,4984	33.695,9310	421,2800
16/09/2007	281.882	49,7748	140.306,2017	254,8469	99,99998	254,8468	47.165	23.476,2844	99,99998	23.476,2797	32.645,7980	33.334,1835	39.557,0290	33.207,7555	438,8300
17/09/2007	290.126	48,8559	141.743,6684	7.857,9829	99,99998	7.857,9813	45.734	22.343,7573	99,99998	22.343,7528	29.938,4069	33.004,6032	36.507,0827	33.267,4479	420,3200
18/09/2007	296.387	48,9413	145.055,6508	9.334,0847	99,99998	9.334,0828	35.999	17.618,3785	99,99998	17.618,3749	32.682,0213	33.402,9266	35.011,1377	33.787,1158	428,3400
19/09/2007	292.252	48,7697	142.530,4236	9.343,2991	99,99998	9.343,2972	36.329	17.717,5443	99,99998	17.717,5407	32.808,8402	27.727,0375	38.969,4287	33.898,8430	420,3500
20/09/2007	277.699	49,3486	137.040,5687	8.515,1009	99,99998	8.515,0991	44.180	21.802,2114	99,99998	21.802,2070	30.589,7166	30.453,5145	34.234,6042	33.344,8490	407,9700
21/09/2007	291.047	48,8743	142.247,1839	8.857,0006	99,99998	8.856,9988	34.809	17.012,6550	99,99998	17.012,6515	31.158,3437	31.047,3990	38.841,3836	31.586,9713	422,0500
22/09/2007	288.744	49,4413	142.758,7872	12.404,3277	99,99998	12.404,3252	32.482	16.059,5230	99,99998	16.059,5197	28.086,6137	33.008,0007	36.990,4974	31.936,1133	411,9200
23/09/2007	284.299	49,4743	140.654,9401	14.220,8927	99,99998	14.220,8898	34.536	17.086,4442	99,99998	17.086,4407	30.821,9941	32.965,7155	36.728,7308	25.021,1324	400,0600
24/09/2007	288.708	48,4284	139.816,6650	12.135,6727	99,99998	12.135,6702	35.593	17.237,1204	99,99998	17.237,1169	32.501,7520	31.744,8162	34.098,4364	28.300,1041	403,5400
25/09/2007	245.444	49,7559	122.122,8711	15.441,2460	99,99998	15.441,2429	35.892	17.858,3876	99,99998	17.858,3840	25.585,4788	26.640,8015	26.749,2693	25.724,7954	326,8600

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm ³)	Methane (%)	Methane Collected (Nm ³)	Methane FIR200 (Nm ³)	F100 Efficiency (%)	Methane Destroyed (Nm ³)	LFG Collected (Nm ³)	Methane FIR700 (Nm ³)	F200 Efficiency (%)	Methne Destroyed (Nm ³)	Methane FIR300 (Nm ³)	Methane FIR400 (Nm ³)	Methane FIR500 (Nm ³)	Methane FIR600 (Nm ³)	Electricity Exported (MWh)
26/09/2007	292.650	49,0100	143.427,7650	12.393,1587	99,99998	12.393,1562	27.644	13.548,3244	99,99998	13.548,3216	31.901,5892	33.555,1866	33.361,1070	30.028,4270	409,4600
27/09/2007	306.301	49,5208	151.682,7056	13.693,9868	99,99998	13.693,9840	6.895	3.414,4591	99,99998	3.414,4584	33.990,5819	33.834,5913	29.378,7098	39.215,5215	432,4600
28/09/2007	296.968	49,3538	146.564,9927	11.171,2326	99,99998	11.171,2303	16.995	8.387,6783	99,99998	8.387,6766	33.827,0945	33.680,0201	29.318,6248	39.116,3412	425,2600
29/09/2007	291.142	48,8954	142.355,0454	3.848,0679	99,99998	3.848,0671	31.831	15.563,8947	99,99998	15.563,8915	33.664,4829	32.561,4026	29.075,1606	37.436,7630	434,5100
30/09/2007	292.391	48,8579	142.856,1023	7.256,3753	99,99998	7.256,3738	30.328	14.817,6239	99,99998	14.817,6209	31.832,8761	31.335,5027	31.686,3024	39.267,0942	425,8900
01/10/2007	292.435	49,1954	143.864,5679	4.342,9699	99,99680	4.342,8309	26.904	13.235,5304	99,99680	13.235,1068	32.882,6973	32.646,0674	32.777,9111	39.830,0717	438,7200
02/10/2007	283.260	49,6781	140.718,1860	6.398,0424	99,99680	6.397,8376	31.690	15.742,9898	99,99680	15.742,4860	33.116,9118	30.029,4178	32.266,9195	37.282,9172	419,9500
03/10/2007	297.948	49,6101	147.812,3007	15.052,6965	99,99680	15.052,2148	22.511	11.167,7296	99,99680	11.167,3722	31.916,6578	33.100,3548	31.887,8839	34.378,8070	416,6100
04/10/2007	295.146	49,3443	145.637,7276	10.745,2147	99,99680	10.744,8708	28.827	14.224,4813	99,99680	14.224,0261	25.846,0508	34.049,0473	35.976,4356	38.606,4868	424,5900
05/10/2007	294.834	49,0868	144.724,5759	8.471,3999	99,99680	8.471,1288	25.678	12.604,5085	99,99680	12.604,1051	28.067,8322	30.070,0828	39.842,7738	38.789,8619	430,0200
06/10/2007	277.011	48,8996	135.457,2709	8.779,9231	99,99680	8.779,6421	23.788	11.632,2368	99,99680	11.631,8645	32.374,9581	26.320,6986	39.028,2377	38.435,0856	429,7300
07/10/2007	287.556	48,7836	140.280,1688	5.298,8746	99,99680	5.298,7050	28.082	13.699,4105	99,99680	13.698,9721	33.146,9926	27.066,1169	38.488,3090	36.129,6219	426,2700
08/10/2007	288.829	48,6463	140.504,6218	3.219,8985	99,99680	3.219,7954	31.785	15.462,2264	99,99680	15.461,7316	34.060,6798	25.413,3135	39.655,4908	37.737,8536	430,7400
09/10/2007	281.025	49,1923	138.242,6610	8.578,6451	99,99680	8.578,3705	28.170	13.857,4709	99,99680	13.857,0274	28.156,6886	28.073,5536	36.553,3223	36.764,3573	402,1100
10/10/2007	282.879	49,4451	139.869,8044	10.774,0872	99,99680	10.773,7424	23.640	11.688,8216	99,99680	11.688,4475	29.826,2732	26.599,9804	34.804,9003	37.798,8011	403,2200
11/10/2007	285.239	49,4184	140.960,5499	14.602,6430	99,99680	14.602,1757	25.269	12.487,5354	99,99680	12.487,1357	32.542,5105	24.605,9155	33.734,9765	35.153,2846	394,4800
12/10/2007	270.761	50,1201	135.705,6839	14.713,7577	99,99680	14.713,2868	17.805	8.923,8838	99,99680	8.923,5982	28.453,6819	21.786,2050	34.497,6648	36.774,6209	372,9800
13/10/2007	281.250	49,0885	138.061,4062	10.554,5183	99,99680	10.554,1805	32.419	15.914,0008	99,99680	15.913,4915	30.990,5518	20.957,3533	38.036,2242	38.415,1874	397,8600
14/10/2007	279.686	48,2102	134.837,1799	10.127,0346	99,99680	10.126,7105	24.449	11.786,9117	99,99680	11.786,5345	27.630,7119	27.406,0523	31.632,1585	37.790,5294	389,0900
15/10/2007	273.939	49,9411	136.808,1499	2.464,5932	99,99680	2.464,5143	25.939	12.954,2219	99,99680	12.953,8073	32.019,2368	28.141,3104	37.488,7861	36.303,6838	418,2100
16/10/2007	245.900	50,1447	123.305,8173	6.335,2813	99,99680	6.335,0785	14.041	7.040,8173	99,99680	7.040,5919	31.997,3330	32.194,4017	38.662,0651	28.922,9615	418,2900
17/10/2007	281.955	50,1918	141.518,2896	10.740,0413	99,99680	10.739,6976	4.134	2.074,9290	99,99680	2.074,8626	25.824,6849	30.730,9333	38.701,3912	35.700,9254	408,4600

DATE	MAIN PIPELINE						SECONDARY PIPELINE				ELECTRICITY GENERATION				
	COLLECTING SYSTEM			FLARE F100			FLARE F200								
	LFG Collected (Nm ³)	Methane (%)	Methane Collected (Nm ³)	Methane FIR200 (Nm ³)	F100 Efficiency (%)	Methane Destroyed (Nm ³)	LFG Collected (Nm ³)	Methane FIR700 (Nm ³)	F200 Efficiency (%)	Methane Destroyed (Nm ³)	Methane FIR300 (Nm ³)	Methane FIR400 (Nm ³)	Methane FIR500 (Nm ³)	Methane FIR600 (Nm ³)	Electricity Exported (MWh)
18/10/2007	296.913	49,3539	146.538,1451	13.144,9177	99,99680	13.144,4970	0	0,0000	99,99680	0,0000	24.157,2534	31.898,4126	38.597,2174	38.820,7906	419,0600
19/10/2007	300.153	48,9046	146.788,6240	15.383,9200	99,99680	15.383,4277	0	0,0000	99,99680	0,0000	25.107,6216	26.723,9186	40.131,1147	40.582,0151	409,4600
20/10/2007	300.413	49,3095	148.132,1482	10.941,2849	99,99680	10.940,9347	0	0,0000	99,99680	0,0000	25.453,5639	31.801,1758	40.041,7794	40.408,6421	424,6200
21/10/2007	296.933	49,2625	146.276,6191	8.767,7397	99,99680	8.767,4591	0	0,0000	99,99680	0,0000	28.751,0728	32.044,7636	38.038,0393	39.140,5341	429,9500
22/10/2007	304.095	48,9534	148.864,8417	6.150,9947	99,99680	6.150,7978	0	0,0000	99,99680	0,0000	29.279,0285	33.061,6577	39.811,8420	40.321,4469	446,3400
23/10/2007	306.064	49,0149	150.016,9635	7.485,0653	99,99680	7.484,8257	0	0,0000	99,99680	0,0000	27.786,0566	34.057,5131	40.558,3593	39.986,8455	443,8900
24/10/2007	312.758	49,1902	153.846,2857	16.587,4273	99,99680	16.586,8965	0	0,0000	99,99680	0,0000	26.207,5547	33.003,6727	40.578,9635	36.825,2594	425,9800
25/10/2007	311.496	50,0708	155.968,5391	18.645,3645	99,99680	18.644,7678	807	404,0713	99,99680	404,0583	29.672,4567	32.020,2766	40.254,9203	34.864,2980	428,4000
26/10/2007	309.642	49,9739	154.740,1834	13.639,8762	99,99680	13.639,4397	0	0,0000	99,99680	0,0000	29.474,6062	31.162,2248	40.107,5529	40.932,6220	441,9800
27/10/2007	307.831	49,5440	152.511,7906	18.352,5839	99,99680	18.351,9966	4.907	2.431,1240	99,99680	2.431,0462	29.348,8747	29.989,4786	39.291,8600	35.900,0778	420,4000
28/10/2007	305.750	49,3420	150.863,1650	11.787,8038	99,99680	11.787,4265	9.393	4.634,6940	99,99680	4.634,5456	29.241,5494	34.205,8480	35.355,5166	40.255,1772	438,4300
29/10/2007	293.102	49,1079	143.936,2370	11.120,4839	99,99680	11.120,1280	17.060	8.377,8077	99,99680	8.377,5396	28.058,7808	32.694,0755	34.260,6175	37.601,4279	417,9000
30/10/2007	282.466	49,0762	138.623,5790	9.695,9848	99,99680	9.695,6745	28.449	13.961,6881	99,99680	13.961,2413	27.363,9075	33.114,6567	32.715,6672	35.196,4691	405,7300
31/10/2007	278.166	49,5496	137.830,1403	12.924,5176	99,99680	12.924,1040	26.250	13.006,7700	99,99680	13.006,3537	26.721,6037	32.859,8082	31.866,8342	33.466,2953	391,2000

2.2.5. Data concerning leakage

According with ACM0001 – version 02, no leakage needs to be considered.

2.3. Special event log

No special event log was identified.

3. Quality assurance and quality control measures

3.1. Documented procedures and management plan

3.1.1. Roles and responsibilities

The following flow-chart represents the procedures and responsibilities on the monitoring of each parameter:

a) Pressure Readings

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Manometer <i>Location:</i> Exit Collector TAG: PT603 <i>Manufacturer:</i> E+H Model: PMC 41 SN.: 5A56701020 Range: -400 to 400 mbar	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho).	The manometer was delivered calibrated (September/2004)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes	ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

b) Temperature Readings

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Thermometer <i>Location:</i> Exit Collector TAG: TT804 <i>Manufacturer:</i> E+H Model: TST 10 S.N.: 42622123 Range: 0 to 100°C	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho).	The thermometer was delivered calibrated (September/2004)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes	ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	Calibration Frequency This device was recalibrated in July/2007.
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		Nex calibration foreseen on July/2012.

c) Total Flow (FIR100)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: <i>Type of Equipment:</i> Digital Flow-meter <i>Location:</i> Exit Collector TAG: FIR100 <i>Manufacturer:</i> Instramet Model: SM-RI-X-K S.N.: 10400826 Range: 800-16.000 m³/h	Equipment: Supervisory System	Equipment: <i>Type of Equipment</i> Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho).	The flow-meter was delivered calibrated (September/2004)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes	ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

d) Flow to Flare F100 (FIR200)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Flows-meter <i>Location:</i> Entrance of flare F100 TAG: FIR200 <i>Manufacturer:</i> Instromet <i>Model:</i> SM-RI-X-K <i>S.N.:</i> 10400827 <i>Range:</i> 320-6.500 m ³ /h	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The flow-meter was delivered calibrated (September/2004)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes		Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

e) Flow to the Power House (FIR300)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital flow-meter <i>Location:</i> entrance of the power house TAG: FIR300 <i>Manufacturer:</i> Instromet <i>Model:</i> VG083B6 <i>Range:</i> 500-7.000 m ³ /h	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The flow-meter was delivered calibrated (December/2006)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes		Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

f) Flow to the Power House (FIR400)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital flow-meter <i>Location:</i> entrance of the power house TAG: FIR400 <i>Manufacturer:</i> Instromet <i>Model:</i> VG084B6 <i>Range:</i> 500-7.000 m ³ /h	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho).	The flow-meter was delivered calibrated (December/2006)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes	ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

g) Flow to the Power House (FIR500)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital flow-meter <i>Location:</i> entrance of the power house TAG: FIR500 <i>Manufacturer:</i> Instromet <i>Model:</i> VG085B6 <i>Range:</i> 500-7.000 m ³ /h	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho).	The flow-meter was delivered calibrated (December/2006)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes	ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

h) Flow to the Power House (FIR600)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital flow-meter <i>Location:</i> entrance of the power house TAG: FIR600 <i>Manufacturer:</i> Instronet Model: VG086B6 Range: 500-7.000 m ³ /h	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The flow-meter was delivered calibrated (December/2006)
Reading Frequency Every 5 seconds	Transmission Frequency Every 5 seconds	Registration Frequency Every 5 minutes		Calibration Frequency Every 5 years
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)		

i) Flow to Flare F200 (FIR700)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital flow-meter <i>Location:</i> after the mini-blower TAG: FIR700 <i>Manufacturer:</i> TZ Model: G 1600 S.N.: 1373501001 Range: 130-2.500 m ³ /h	Equipment: Manually	Equipment: Operation Diary and Excel Spreadsheets	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The flow-meter was delivered calibrated (May/2007)
Reading Frequency Every 5 seconds	Transmission Frequency Every 3 hours	Registration Frequency Every 3 hours		Calibration Frequency Every 5 years
Responsibility Plant operator (every 3 hours). The value read is an accumulated of 3 hours.	Responsibility Plant operator and plant supervisor (every 3 hours)	Responsibility Plant operator and plant supervisor (every 3 hours)		

j) Methane Concentration

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: <i>Type of Equipment:</i> Methane Analyzer <i>Location:</i> Analyzer Room TAG: A100 <i>Manufacturer:</i> NUK <i>Model:</i> Binos 100-CH ₄ -O ₂ <i>Range:</i> O ₂ (0-21%) CH ₄ (0-100%)	Equipment: Supervisory System	Equipment: Supervisory System and SQL Database	Every week, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The analyzer was delivered calibrated (December/2003)
Reading Frequency Every 5 minutes	Transmission Frequency Every 5 minutes	Registration Frequency Every 5 minutes		Calibration Frequency Weekly, with a standard gas certified by INMETRO
Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility PLC (continuously) and plant supervisor (monthly)	Responsibility Plant supervisor (monthly)		

k) Flare Efficiency

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: According with APEX-EPA 18 <i>Location:</i> <i>Manufacturer:</i> <i>Model:</i> <i>Range:</i>	Equipment: MS Excel Spreadsheets	Equipment: MS Excel Spreadsheets	Every 3 months, Biogás (Antônio Carlos Delbin and Tiago Nascimento) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	N/A
Reading Frequency Every 3 months	Transmission Frequency N/A	Registration Frequency N/A		Calibration Frequency N/A
Responsibility Specialized company on gas analysis	Responsibility Plant supervisor (every 3 months)	Responsibility Plant supervisor (every 3 months)		

3.1.2. Trainings

All training was supplied before the project's implementation and as verified during the 1st verification. No employees were hired during the Monitoring Period.

4. Calculation of GHG emission reductions

4.1. Table providing the formulas used

Variable	Description
A	Total methane sent to flare F100 measured by FIR200
B	Flare Efficiency
$C = A \cdot B$	Total methane destroyed in the flare F100
D	Gas-flow error
E	Temperature error
F	Pressure error
G	Methane Concentration error
$H = \sqrt{D^2 + E^2 + F^2 + G^2}$	Total error from measuring equipment
$I = C \cdot (1-H)$	Total methane corrected destroyed at the flare F100
A ₁	Total methane sent to flare F200 measured by FIR700
B ₁	Flare Efficiency
$C_1 = A_1 \cdot B_1$	Total methane destroyed in the flare F200
D ₁	Gas-flow error
E ₁	Temperature error
F ₁	Pressure error
G ₁	Methane Concentration error
$H_1 = \sqrt{D_1^2 + E_1^2 + F_1^2 + G_1^2}$	Total error from measuring equipment
$I_1 = C_1 \cdot (1-H_1)$	Total methane corrected destroyed at the flare F200
J _{FIRi} ¹	Methane flow to the power house measured by FIRi
K _{FIRi} ¹	Gas-flow error of FIRi
L _{FIRi} ¹	Temperature error of FIRi
M _{FIRi} ¹	Pressure error of FIRi
N _{FIRi} ¹	Methane Concentration error
$O_{FIRi}^1 = \sqrt{K_{FIRi}^2 + L_{FIRi}^2 + M_{FIRi}^2 + N_{FIRi}^2}$	Total measuring error from FIRi
$P_{FIRi}^1 = J_{FIRi} \cdot (1 - O_{FIRi})$	Total methane corrected measured by FIRi
$Q = P_{FIR300} + P_{FIR400} + P_{FIR500} + P_{FIR600}$	Total methane corrected destroyed at the electricity
$R = I + I_1 + Q$	Total methane destroyed in the period
S = 0,0007168	Density of Methane at the STPC
T = R · S	Total weight of methane destroyed
U = 21	CO ₂ equivalency

¹ Obs: calculation made individually for each Flow-Meter (FIR₃₀₀, FIR₄₀₀, FIR₅₀₀ and FIR₆₀₀)

$V = T \cdot U$	Total equivalent carbon
$W = 20\%$	Adjustment Factor
$X = V \cdot (1-W)$	Total Liquid Carbon
Y	Total electricity exported
Z	Electricity-meter error
$AA = Y \cdot (1 - Z)$	Total electricity corrected
$AB = 0,2677$	Emission Factor
$AC = AA \cdot AB$	Total CO₂e from the energy exported
$AD = X + AC$	TOTAL CREDITS DURING THE PERIOD

To calculate the Flare Efficiency, the following formulae were applied:

a) Calculate the volume of CH₄ sent to flares F_i ($Flow_{methane}$), measured by the equipment FIR_i :

$$Flow_{methane} = Flow_{FIR_i} \times \frac{\%_{methane}}{100}$$

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

$$Flow_{remaining} = Flow_{FIR_i} - Flow_{methane}$$

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

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

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

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

e) Calculate the Flare Efficiency (FE):

$$FE = \frac{(Flow_{methane} \times 0,714) - \frac{M_{methane}}{1000}}{(Flow_{methane} \times 0,714)} \times 100$$

TASQA made an analysis of the methane content in the exhaust gas of the flares F200 and F100 on 21/03/2007. BIOAGRI made an analysis of the methane content in the exhaust gas of the flares F200 and F100 on 29/09/2007.

Flare	March/2007	September/2007
F100	< 0,02 mg/Nm ³	3,25 mg/Nm ³
F200	< 0,02 mg/Nm ³	2,23 mg/Nm ³

Other parameters used to calculate the flare efficiency were:

Measurement	Flow _{FIRi}		Methane %	
	FIR200	FIR700	FIR200	FIR700
March/2007	2.310 Nm ³ /h	2.350 Nm ³ /h	50,00%	49,90%
September/2007	2.340 Nm ³ /h	1.942 Nm ³ /h	48,91%	49,82%

The results were:

Measurement	Flare Efficiency Calculated	
	F100	F200
March/2007	99,9998%	99,9998%
September/2007	99,9968%	99,9977%

The flare efficiency adopted from 01/07/2007 to 30/09/2007 is 99,9998%. The flare efficiency adopted from 01/10/2007 on is 99,9968% (the lowest efficiency calculated).

4.2. Description and consideration of measurement uncertainties and error propagation

The formulae used to calculate the error of methane flow was (given specific error for each monitoring equipment, as presented on 2.1):

$$\varepsilon_{FIR-i} = \sqrt{(\varepsilon_{Gas\ Flow})^2 + (\varepsilon_{Temperature})^2 + (\varepsilon_{Pressure})^2 + (\varepsilon_{Methane\ Analysis})^2}$$

4.2.1. Gas to Flares

$$\varepsilon_{FIR200} = \sqrt{0,600^2 + 0,010^2 + 0,010^2 + 1,000^2} = 1,1633\%$$

$$\varepsilon_{FIR700} = \sqrt{0,330^2 + 0,010^2 + 0,010^2 + 1,000^2} = 1,0352\%$$

4.2.2. Gas to the Power House

$$\varepsilon_{FIR300} = \sqrt{0,772^2 + 0,050^2 + 0,033^2 + 1,000^2} = 1,265\%$$

$$\varepsilon_{FIR400} = \sqrt{0,330^2 + 0,010^2 + 0,010^2 + 1,000^2} = 1,166\%$$

$$\varepsilon_{\text{FIR500}} = \sqrt{0,810^2 + 0,050^2 + 0,370^2 + 1,000^2} = 1,340\%$$

$$\varepsilon_{\text{FIR600}} = \sqrt{0,632^2 + 0,050^2 + 0,444^2 + 1,000^2} = 1,265\%$$

4.3. GHG emission reductions

Total CO ₂ e from methane destroyed	236.376
Total CO ₂ e from electricity dispatched	13.365
TOTAL CO₂e	249.741

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