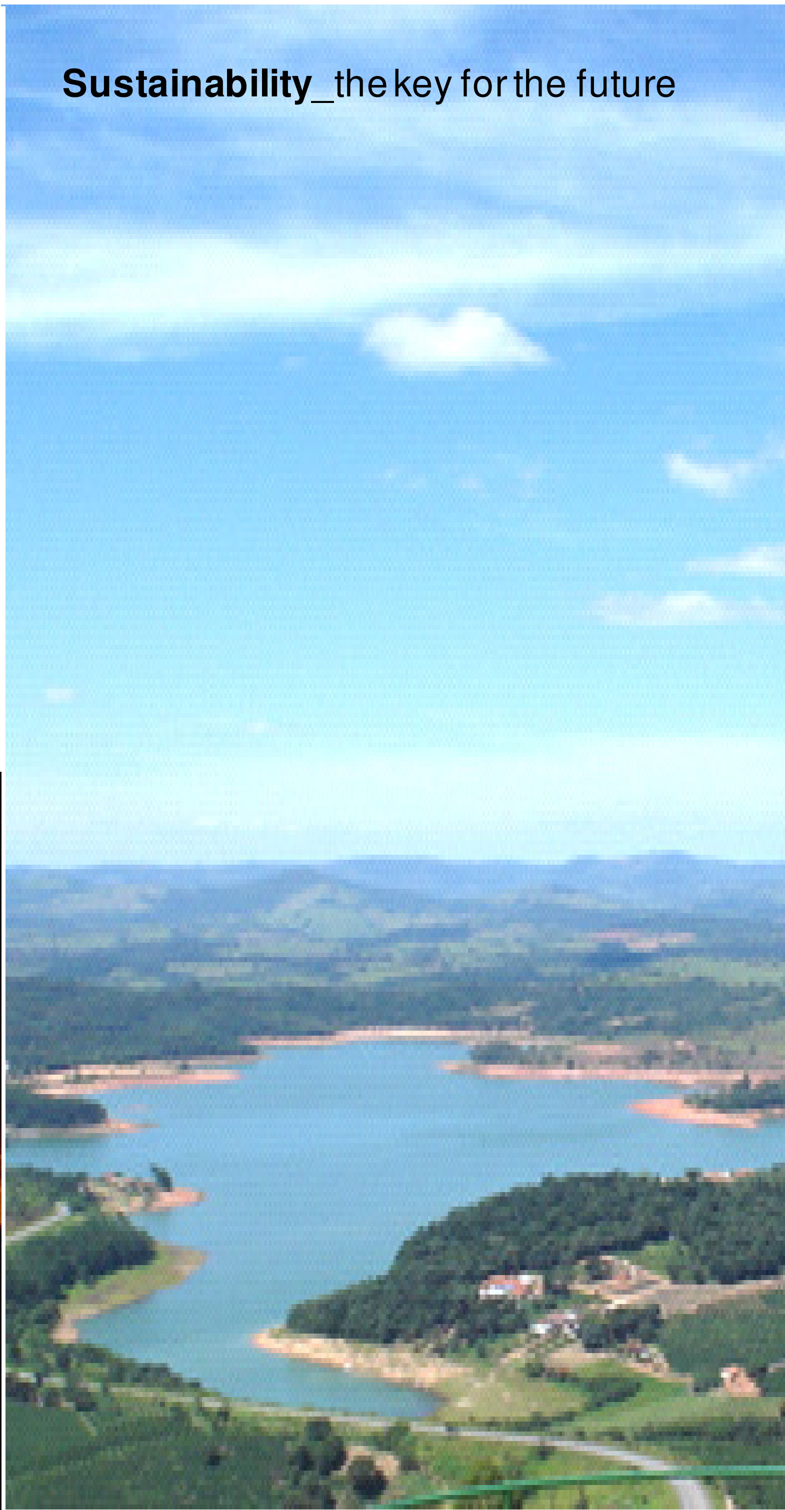
ARCADIS TETRAPLAN

Imagine the result

Sustainability_the key for the future



São João Landfill Gas to Energy Project (SJ)

Monitoring Report – Version 01
3rd Verification
Monitoring Period: 01/11/2007 to 31/12/2007

São Paulo, January 7th 2008

Clean Development Mechanism

Monitoring Report – Version 01

São João Landfill Gas to Energy Project (SJ)

3rd Verification
Monitoring Period: 01/11/2007 to 31/12/2007

Biogás Energia Ambiental SA

São Paulo
January 7th, 2008

ARCADIS TETRAPLAN

Table of Contents

List of Figures

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

São João Landfill Gas to Energy Project (SJ), Registration Number 0373

1.2. Short Description of the Project Activity:

São João Landfill Gas to Energy Project (SJ) is a project designed to explore the landfill gas produced in São João 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. São João Landfill Gas to Energy Project (SJ)'s goal is to explore the gas produced in São João landfill, using it to generate electricity.

1.3. Real Project Implementation

The SJ includes high density polyethylene pipes connected to the landfill wells; blowers to extract the gas from the landfill; facilities for gas treatment, such as heat exchangers, chillers; and the flares, which will destroy the methane previously released to the atmosphere. The project will also produce 20 MW of electricity from January 25th 2008 on (by the time of the 2nd Verification, the power house was under construction – the engines were already acquired).

The degassing station will be responsible for extracting the landfill gas from the landfill and transport it to the flares and, in the future, 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 station 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.

The landfill gas will be cooled down when transported from the landfill, resulting in a condensate. This will be drained to condensate shafts, to be placed nearby the gas pipes. Once in the degassing station, the gas will be measured and sent to a flaring system. Biogás will install chillers in order to remove moisture in July/2007 – the chiller was already acquired. 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 will be heated again through a second heat exchanger, or economizer, to a temperature of around 25ºC, far enough from the dew point of 4ºC to avoid further condensation.

Blowers will be used for transportation of the landfill gas from the landfill to the flares. These blowers will be equipped with all the necessary safety equipment, including a noise reducing housing.

The figure below presents the installation of all collecting equipment from SJ, the location of the degassing station and the future location of the power house.

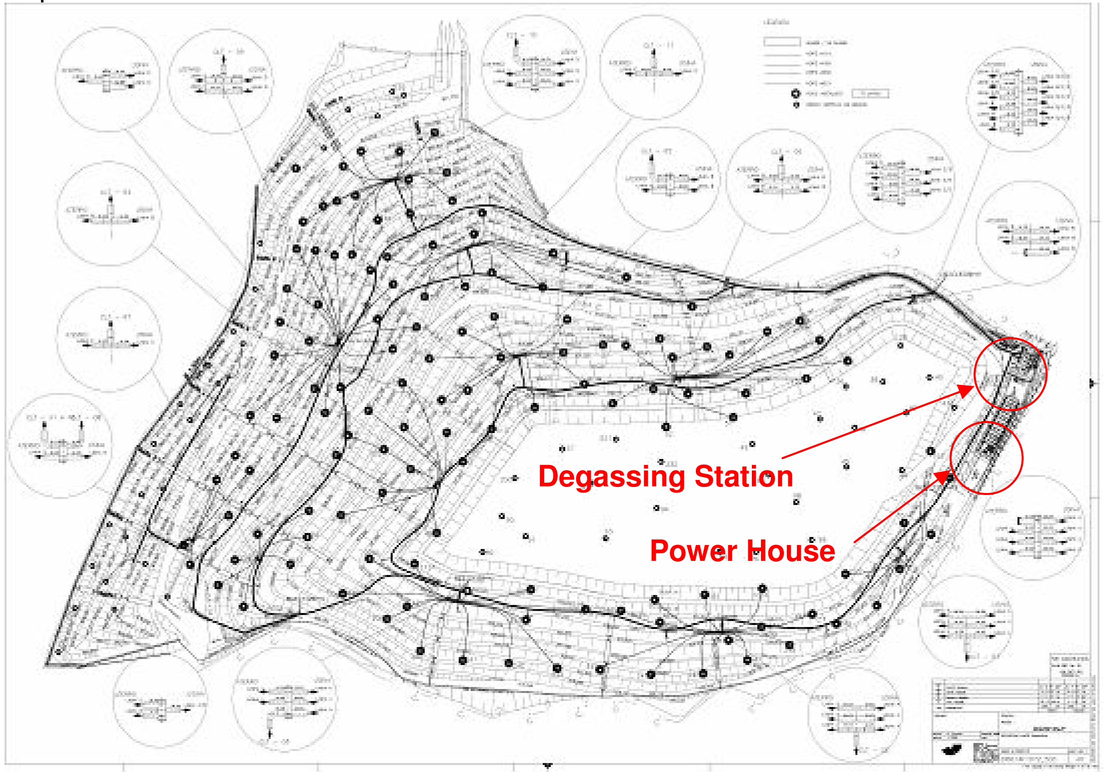


Figure 1.1: SJ Lay-out

Figure 1.2: Degassing Station

Figure 1.3: Future location of the Power House

The pictures below illustrate the collecting system of the SJ project.

Figure 1.4: Wellhead

Figure 1.5: Wellhead and Collection Pipeline

Figure 1.6: Transmission Pipeline

Figure 1.7: Gas entrance in the Degassing Station

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. SJ counts, actually, with three turbine flow-meters: one measures the total gas collected (tag FIR600) and the other two measures the gas sent to the flaring system and to the future power house (tags: FIR500 and FIR800, respectively).

While the power house has not been installed, SJ generates electricity through a diesel engine installed in the degassing station. The electricity produced is registered continuously by the PLC and the diesel consumed is registered via the contract between Biogás and the diesel supplier.

The pictures below presents the above mentioned installed equipment and the lay-out of the degassing station locating of the measuring equipment (installed and to be installed).

Figure 1.8: FIR600

Figure 1.9: FIR500 and FIR800

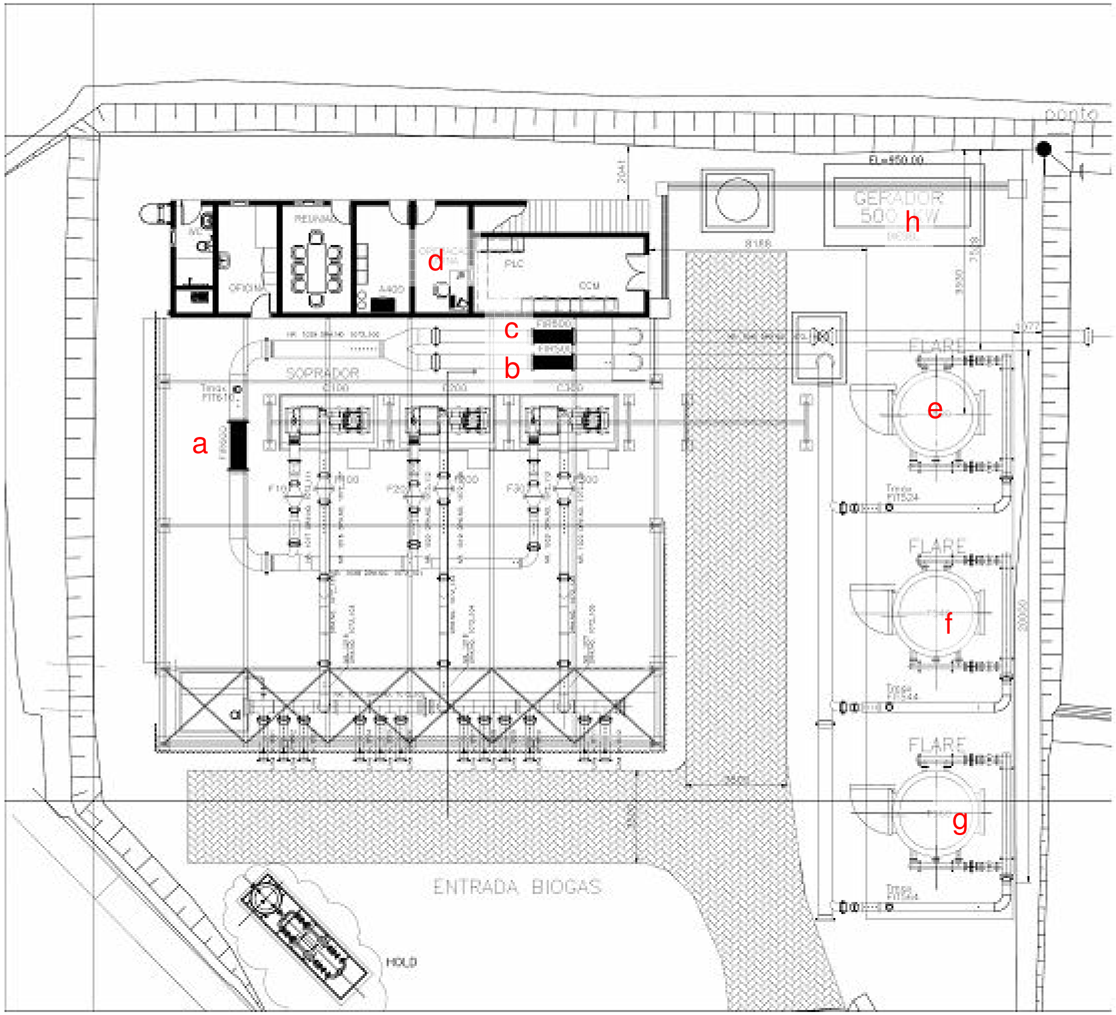
Figure 1.10: Flares F520, F540 and F560

Figure 1.11: Blower

Figure 1.12: Detail of the blower

Figure 1.13: Future location of the chiller

Figure 1.14: Methane Analyser A400



a) FIR600 – Turbine Flow-mete
b) FIR500 – Turbine Flow-meter
c) FIR800 – Turbine Flow-meter
d) A400 – Methane Analyzer
e) F520 – Flare
f) F540 – Flare
g) F560 – Flare
h) Diesel Electricity Generator

Figure 1.15: Lay-out of the Degassing Station

The whole process will be controlled by an electrical control system. This control system will be provided with a PLC (Programmable Logical Controller). All the measured process signals will be processed by the PLC to output signals for the gas-coolers, blowers, flares and gas-engines. Also the system will count on a SCADA system (visualization of the process on a personal computer). With this system it will be possible to control and monitor the installation at a distance, including through the internet.

The picture below presents the screen of the PLC.

Figure 1.16: Screen of the PLC

1.4. Changes against the PDD

From the registered PDD, the following changes were presented:

- The operation of the project only with flares. The project will begin to generate electricity only on January 25th 2008.
- As SJ is not connected to the local distribution grid, the electricity supplied is produced by a diesel generator. This source of project emission was considered in the calculation of emission reduction;
- differently from Annex 4 – Monitoring Plan, 3 (three) flow-meters were installed instead of the 2 (two) mentioned: the first to measure the total flow, the second to measure the gas sent to the flares and the third to measure the methane sent to the power house.

- Starting date of the project activity was moved from 30/06/2006 to 22/05/2007 due to the bureaucratic process of Environmental Licensing and due to the negotiation aiming the electricity sale (PPA), which delayed the start of the project's civil works.

1.5. Monitoring Period

The monitoring period is from 01/11/2007 to 31/12/2007.

1.6. Methodology applied to the project activity (incl. version number):

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 2nd Verification.

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

This monitoring report was developed and revised by:

Eduardo Cardoso Filho
ARCADIS Tetraplan S/A
Avenida Nove de Julho, 5966 – Térreo
São Paulo – SP
Brazil
CEP: 01406-200
Phone/Fax: + 55 (11) 3060-8457
http://www.tetraplan.com.br
eduardo@tetrapan.com.br

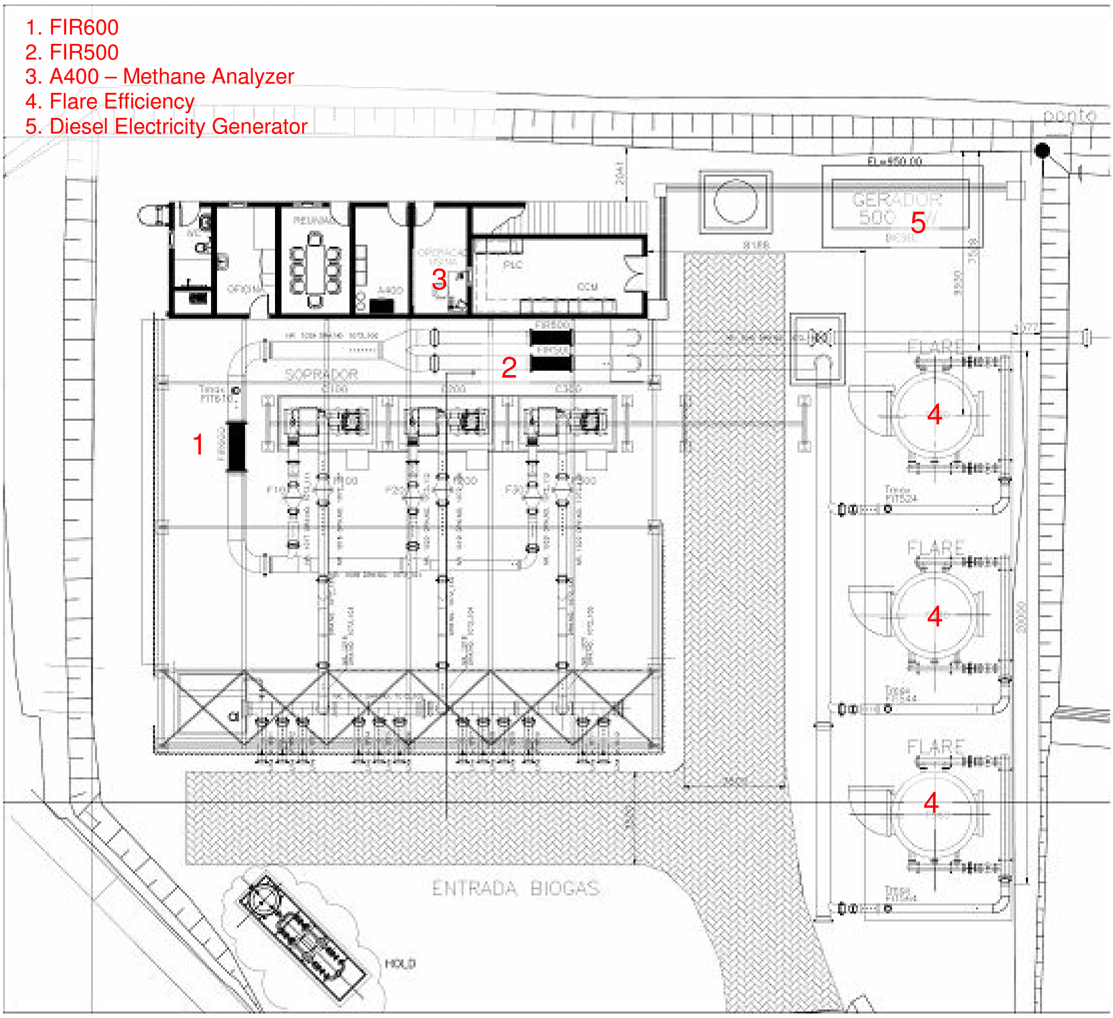
Júlio César do Prado
Biogás Energia Ambiental
Estrada do Sapopemba, 23.235
São Paulo – SP
Brazil
CEP: 08310-130
Phone/Fax: + 55 (11) 6734-8862
http://www.biogas-ambiental.com.br
julio@biogas-ambiental.com.br

2. Key monitoring activities according to the monitoring plan for the monitoring period

2.1. Monitoring equipment:

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

2.1.1. Degassing Station



1. Flow-meter FIR600 (Total Gas Collected) [1]

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Turbine Flow-meter	Instromet	SM-RI G16000-600-10-K-HF	0,4800
Temperature	Temperature Transmitter	Yokogawa	YTA110	0,0200
Pressure	Pressure Transmitter	Yokogawa	EJA510A	0,0300

2. Flow-meter FIR500 (Gas sent to the flaring system)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Turbine Flow-meter	Instromet	SM-RI G10000-600-10-K-HF	0,9800
Temperature	Temperature Transmitter	Yokogawa	YTA110	0,0300
Pressure	Pressure Transmitter	Yokogawa	EJA510A	0,0100

3. Methane Analyzer A400

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Methane Analyzer	Analyser Panel	Fisher & Rosemount	Binos 100	1,0000%

4 – Exhaust Gas Methane Concentration

Analysis made by specialized company.

5. Electricity Meter

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Electricity Consumed	Electricity Meter	SIEMENS	MMGE 144	0,5%

2.1.2. Involvement of Third Parties:

For this 3rd Verification SJ had only one third party involved:

- Specialized company on gas analysis: as the analysis of methane concentration in the exhaust gas is made periodically, Biogás hired BIOAGRI, a national and certified laboratory, to develop the analysis.

Also, another other party is involved (indirectly) in the project: NEXT Solutions (company responsible for the automation of the system). Van der Wiel (one of Biogás's shareholders) is the only company who has external access to the data registered from the PLC.

[1] The Turbine flow-meters installed are connected to a pressure and temperature transmitters, which allows the device to use those variables to make the conversion automatically to Nm^3. Thus, separate readings from pressure and temperature were not considered and the erros from the transmitters were discounted from the final calculation (refer to 4.2)

2.2. Data collection (accumulated for the whole monitoring period):

2.2.1. List of fixed default values:

Global Warming Potential of CH_4 (GWP_{CH4}) = 21 tCO_2e/tCH_4;
Density of Methane, at STP (D_{CH4}) = 0,0007168 tons/Nm^3
Emission Factor of Diesel Engines = 0,9 tCO_2e/MWh[2]

2.2.2. List of variables:

$Q_{biogas, collected}$ = amount of biogas collected from the landfill (Nm^3)
$Q_{biogas, flares}$ = amount of biogas sent to flares (Nm^3)
$\%_{CH4}$ = percentage of methane in the biogas (% volume);
$EG_{FF, y}$ = amount of electricity consumed from the diesel engines (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. Table of all data monitored.

[2] Emisison factor recommended from IPCC's Inventory Guidelines, 1996, more conservative to calculate project emissions than the factor from the IPCC Guidelines 2006.

DAY	COLLECTING SYSTEM			FLARING SYSTEM				Electricity Consumed from the Diesel Generators (MWh)
	LFG Collected (Nm^3)	Methane (%)	Methane Collected (Nm^3)	LFG sent Flares (Nm^3)	Methane sent to Flares (Nm^3)	Flaring System Efficiency (%)	Total Methane Destroyed (Nm^3)	
01/11/2007	304.939	55,0989	168.018,0346	304.531	167.793,2311	99,9950%	167.784,8414	1,7289
02/11/2007	320.722	55,3888	177.644,0671	320.320	177.421,4041	99,9950%	177.412,5330	1,7028
03/11/2007	318.452	55,6954	177.363,1152	318.044	177.135,8779	99,9950%	177.127,0211	1,6689
04/11/2007	320.658	55,8392	179.052,8619	320.273	178.837,8810	99,9950%	178.828,9391	1,6722
05/11/2007	328.602	54,3639	178.640,8626	328.162	178.401,6615	99,9950%	178.392,7414	1,7984
06/11/2007	328.366	53,8789	176.919,9887	327.938	176.689,3870	99,9950%	176.680,5525	1,8425
07/11/2007	326.611	53,6207	175.131,1044	326.188	174.904,2889	99,9950%	174.895,5436	1,8331
08/11/2007	324.975	53,5107	173.896,3973	324.491	173.637,4055	99,9950%	173.628,7236	1,8392
09/11/2007	322.711	53,0725	171.270,7954	322.298	171.051,6060	99,9950%	171.043,0534	1,8707
10/11/2007	322.863	51,9694	167.789,9639	322.381	167.539,4714	99,9950%	167.531,0944	1,8817
11/11/2007	324.081	52,3967	169.807,7493	323.625	169.568,8203	99,9950%	169.560,3418	1,8814
12/11/2007	302.981	53,7479	162.845,9248	302.468	162.570,1981	99,9950%	162.562,0695	1,7268
13/11/2007	314.456	54,3985	171.059,3471	313.888	170.750,3636	99,9950%	170.741,8260	1,8380
14/11/2007	305.965	53,7299	164.394,6885	305.393	164.087,3535	99,9950%	164.079,1491	1,7939
15/11/2007	301.535	54,3031	163.742,8525	300.895	163.395,3127	99,9950%	163.387,1429	1,7391
16/11/2007	304.915	55,4282	169.008,8960	304.274	168.653,6012	99,9950%	168.645,1685	1,7441
17/11/2007	308.730	56,2736	173.733,4852	308.112	173.385,7144	99,9950%	173.377,0451	1,7812
18/11/2007	306.969	55,9154	171.642,9442	306.363	171.304,0969	99,9950%	171.295,5316	1,7888
19/11/2007	308.549	55,3571	170.803,7784	307.999	170.499,3144	99,9950%	170.490,7894	1,8105
20/11/2007	321.996	54,3873	175.124,9305	321.451	174.828,5197	99,9950%	174.819,7782	1,9813
21/11/2007	318.797	54,4039	173.438,0010	318.206	173.116,4740	99,9950%	173.107,8181	1,9568
22/11/2007	301.121	55,0538	165.778,5530	300.345	165.351,3356	99,9950%	165.343,0680	1,8077
23/11/2007	282.343	55,2003	155.854,1830	281.559	155.421,4126	99,9950%	155.413,6415	1,6860

DAY	COLLECTING SYSTEM			FLARING SYSTEM				Electricity Consumed from the Diesel Generators (MWh)
	LFG Collected (Nm^3)	Methane (%)	Methane Collected (Nm^3)	LFG sent Flares (Nm^3)	Methane sent to Flares (Nm^3)	Flaring System Efficiency (%)	Total Methane Destroyed (Nm^3)	
24/11/2007	309.343	54,5343	168.698,0396	308.617	168.302,1206	99,9950%	168.293,7054	1,8623
25/11/2007	308.624	54,1152	167.012,4948	307.922	166.632,6061	99,9950%	166.624,2744	1,8747
26/11/2007	311.871	54,1326	168.823,8809	311.154	168.435,7502	99,9950%	168.427,3284	1,8983
27/11/2007	318.658	54,1935	172.691,9232	318.012	172.341,8332	99,9950%	172.333,2161	1,9052
28/11/2007	309.232	54,8050	169.474,5976	308.337	168.984,0928	99,9950%	168.975,6435	1,8653
29/11/2007	320.602	54,9857	176.285,2539	319.343	175.592,9839	99,9950%	175.584,2042	1,9766
30/11/2007	316.884	55,0884	174.566,3254	315.753	173.943,2756	99,9950%	173.934,5784	1,9678
01/12/2007	318.574	54,7304	174.356,8244	317.483	173.759,7158	99,9950%	173.751,0278	1,9969
02/12/2007	321.447	54,7021	175.838,2593	320.374	175.251,3058	99,9950%	175.242,5432	2,0483
03/12/2007	320.960	53,7873	172.635,7180	319.539	171.871,4005	99,9950%	171.862,8069	2,0667
04/12/2007	294.634	53,9395	158.924,1064	293.789	158.468,3176	99,9950%	158.460,3941	1,7926
05/12/2007	315.813	53,6916	169.565,0527	314.985	169.120,4862	99,9950%	169.112,0301	1,9078
06/12/2007	313.920	54,1000	169.830,7200	313.075	169.373,5750	99,9950%	169.365,1063	1,9534
07/12/2007	313.742	54,8641	172.131,7246	312.908	171.674,1580	99,9950%	171.665,5742	1,9138
08/12/2007	315.083	55,0354	173.407,1893	314.229	172.937,1870	99,9950%	172.928,5401	1,9193
09/12/2007	314.892	54,7538	172.415,3358	314.057	171.958,1416	99,9950%	171.949,5436	1,9246
10/12/2007	316.541	54,6135	172.874,1190	315.702	172.415,9117	99,9950%	172.407,2909	1,9968
11/12/2007	318.145	55,0292	175.072,6483	317.325	174.621,4089	99,9950%	174.612,6778	2,0530
12/12/2007	319.990	56,1989	179.830,8601	319.216	179.395,8806	99,9950%	179.386,9108	2,0307
13/12/2007	319.993	56,5094	180.826,1243	319.193	180.374,0491	99,9950%	180.365,0303	1,9971
14/12/2007	315.478	56,9360	179.620,5540	314.684	179.168,4822	99,9950%	179.159,5237	1,9767
15/12/2007	313.953	57,1161	179.317,7094	313.119	178.841,3611	99,9950%	178.832,4190	1,9760
16/12/2007	313.785	56,8397	178.354,4526	312.961	177.886,0935	99,9950%	177.877,1991	1,9882
17/12/2007	315.373	56,6787	178.749,3165	314.527	178.269,8147	99,9950%	178.260,9012	2,0219

DAY	COLLECTING SYSTEM			FLARING SYSTEM				Electricity Consumed from the Diesel Generators (MWh)
	LFG Collected (Nm^3)	Methane (%)	Methane Collected (Nm^3)	LFG sent Flares (Nm^3)	Methane sent to Flares (Nm^3)	Flaring System Efficiency (%)	Total Methane Destroyed (Nm^3)	
18/12/2007	259.323	54,8138	142.144,7905	258.817	141.867,4327	99,9950%	141.860,3393	1,6587
19/12/2007	319.332	55,0084	175.659,4238	319.012	175.483,3970	99,9950%	175.474,6228	2,0422
20/12/2007	317.300	55,1780	175.079,7940	316.900	174.859,0820	99,9950%	174.850,3390	2,0529
21/12/2007	318.740	55,1763	175.868,9386	318.349	175.653,1992	99,9950%	175.644,4165	2,0556
22/12/2007	321.611	55,3347	177.962,4820	321.173	177.720,1160	99,9950%	177.711,2299	2,0856
23/12/2007	321.671	54,8218	176.345,8322	321.270	176.125,9968	99,9950%	176.117,1905	2,0803
24/12/2007	321.295	54,7577	175.933,7522	320.867	175.699,3892	99,9950%	175.690,6042	2,1023
25/12/2007	320.307	54,6098	174.919,0120	319.932	174.714,2253	99,9950%	174.705,4895	2,0877
26/12/2007	322.207	54,2773	174.885,2600	321.365	174.428,2451	99,9950%	174.419,5236	2,1208
27/12/2007	322.596	53,9968	174.191,5169	321.783	173.752,5229	99,9950%	173.743,8352	2,1421
28/12/2007	261.719	54,2132	141.886,2449	260.831	141.404,8316	99,9950%	141.397,7613	1,6883
29/12/2007	293.558	54,5943	160.265,9351	292.399	159.633,1872	99,9950%	159.625,2055	1,8705
30/12/2007	320.861	55,4867	178.035,1804	319.710	177.396,5285	99,9950%	177.387,6586	2,0644
31/12/2007	323.042	55,2635	178.524,3156	321.804	177.840,1535	99,9950%	177.831,2614	2,1122

2.2.4. Data concerning leakage:

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

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, according with an internal procedure from Biogás:

a) Pressure Readings[3]

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Manometer *Location:* Exit Collector *TAG:* PT603 *Manufacturer:* E+H *Model:* Cerabar PMC41 GE1 2F 1H1 1N1 *Range:* 0 to 400 mbar **Reading Frequency** Every 5 seconds **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Equipment:** Supervisory System **Transmission Frequency** Every 5 seconds **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Equipment:** Supervisory System and SQL Database **Registration Frequency** Every 5 minutes **Responsibility** PLC (continuously) and plant supervisor (monthly)	Every week, Biogás (Júlio César Prado and Daniel Picanço) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The manometer was delivered calibrated (Apr/2007) **Calibration Frequency** Every 3 years

[3] Pressure measured from PT603 is the same pressure measured by the pressure transmitters from FIR500 and FIR600, as the manometer is located close to the flow-meters. However, those devices are not used to calculate ERs (as mentioned on footnote 1, the convertion to Nm^3 is made automaticaly).

b) Temperature Readings[4]

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Thermometer *Location:* Exit Collector *TAG:* TT 604 *Manufacturer:* E+H *Model:* TMT187-B31FGA *Range:*0 to 150°C	**Equipment:** Supervisory System	**Equipment:** Supervisory System and SQL Database	Every week, Biogás (Júlio César Prado and Daniel Picanço) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The thermometer was delivered calibrated (Apr/2007)
Reading Frequency Every 5 seconds	**Transmission Frequency** Every 5 seconds	**Registration Frequency** Every 5 minutes		**Calibration Frequency** Every 3 years
Responsibility PLC (continuously) and plant supervisor (monthly)	**Responsibility** PLC (continuously) and plant supervisor (monthly)	**Responsibility** PLC (continuously) and plant supervisor (monthly)		

c) Total Flow (FIR600)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Turbine flow-meter *Location:* Exit Collector *TAG:* FIR600 *Manufacturer:* Instromet *Model:* SM-RI G16000-600-10-K-HF *Range:* 1.300 – 25.000 m^3/h	**Equipment:** Supervisory System	**Equipment:** Supervisory System and SQL Database	Every week, Biogás (Júlio César Prado and Daniel Picanço) 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 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)		

[4] Temperature measured from TT604 is the same tempreature measured by the transmitters located in FIR500 and FIR600, as the thermometer is located close to the flow-meters. However, those devices are not used to calculate ERs (as mentioned on footnote 1, the convertion to Nm^3 is made automaticaly).

d) Flow to Flaring System (FIR500)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Turbine flow-meter *Location:* Exit Collector *TAG:* FIR500 *Manufacturer:* Instromet *Model:* SM-RI G10000-600-10-K-HF *Range:* 800-16.000 m^3/h	**Equipment:** Supervisory System	**Equipment:** Supervisory System and SQL Database	Every week, Biogás (Júlio César Prado and Daniel Picanço) 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 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) Methane Concentration

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Methane Analyzer *Location:* Analyzer Room *TAG:* A400 *Manufacturer:* Fisher & Rosemount *Model:* Binos 100-CH_4 *Range:* 0-100%	**Equipment:** Supervisory System	**Equipment:** Supervisory System and SQL Database	Every week, Biogás (Júlio César Prado and Daniel Picanço) 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 (Apr/2007)
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** PLC (continuously) and plant supervisor (monthly)		

f) Flare Efficiency

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: According with the company hired *Location* *Manufacturer* *Model* *Range* **Reading Frequency** Every 3 months **Responsibility** Specialized company on gas analysis	**Equipment:** MS Excel spreadsheet **Transmission Frequency** Every 3 years **Responsibility** Plant supervisor (every 3 months)	**Equipment:** MS Excel spreadsheet **Registration Frequency** Every 3 years **Responsibility** Plant supervisor (every 3 months)	Every 3 weeks, Biogás (Júlio César Prado and Daniel Picanço) 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 **Calibration Frequency** N/A

g) Electricity Consumption

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Electricity-meter *Location:* Diesel Generator *Manufacturer:* SIEMENS *Model:* MMGE 144 *Range:* 0 -100 MWh[5] **Reading Frequency** Every 5 seconds **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Equipment:** Supervisory System **Transmission Frequency** Every 5 seconds **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Equipment:** Supervisory System and SQL Database **Registration Frequency** Every 5 minutes **Responsibility** PLC (continuously) and plant supervisor (monthly)	Every week, Biogás (Júlio César Prado and Daniel Picanço) send the data by e-mail to ARCADIS Tetraplan (Eduardo Cardoso Filho). ARCADIS Tetraplan is responsible for checking and developing the Monitoring Report.	The electricity-meter was delivered calibrated (May/2007) **Calibration Frequency** Every 5 years

3.1.2. Trainings:

All training was supplied before the project’s implementation. The training certificates were presented to the Verification Team.

[5] After 100 MWh, the electricity-meter is reseted (the count continues from 0)

3.1.3. Calibration:

According with an internal procedure from Biogás, the measuring equipment will be calibrated according with the following table:

Equipment	Location	Date of the last calibration	Date of the next calibration
Turbine flow-meter FIR600	Degassing Station (totalizer)	May/2007	May/2012
Turbine flow-meter FIR500	Degassing Station (gas to the flares)	May/2007	May/2012
Turbine flow-meter FIR800	Degassing Station (gas to the power house)	May/2007	May/2012
Methane Analyzer (Binos 100-CH_4)	Degassing Station	Apr/2007	Weekly
Electricity Meter	Diesel Generator	May/2007	May/2012

4. Calculation of GHG emission reductions

4.1. Table providing the formulas used:

Variable	Description
A	Methane sent to flaring system, measured by FIR500 (Nm^3)
B	Flare Efficiency (%)
C = A . B	Total methane destroyed in flares (Nm^3)
D	FIR500 error (%)
E	Temperature Error (%)
F	Pressure Error (%)
G	Methane Concentration error (%)
$H = \sqrt{D^2 + E^2 + F^2 + G^2}$	Total error of FIR500 (%)
I = C . (1-H)	**Total methane destroyed corrected at flares corrected (Nm^3)**
J = 0,0007168	Density of Methane at the STPC (tCH_4/Nm^3)
K = I . J	Total weight of methane destroyed (tCH_4)
L = 21	CO_2 equivalency (tCO_2e/tCH_4)
M = K . L	Total equivalent carbon (tCO_2e)
N = 20%	Baseline (%)
O = M . (1-N)	**Total Liquid Carbon (tCO_2e)**
P	Electricity consumed from the diesel generators (MWh)
Q = 0,9 tCO_2/MWh	Diesel CO_2 Emission Factor (tCO_2e/MWh)
R	Error from the electricity meter (%)
S = P . Q . (1+R)	**Project Emissions due to the consumption of electricity corrected (tCO_2e/MWh)**
T = O – S	**TOTAL CREDITS DURING THE MONITORING PERIOD (tCO_2e)**

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

a) Calculate the volume of CH_4 sent to flares F_i ($Flow_{methane}$), measured by the equipment FIR_{500}

$$Flow_{methane} = Flow_{FIR\ 500} \times \frac{\%_{methane}}{100}$$

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

$$Flow_{remaining} = Flow_{FIR500} - Flow_{methane}$$

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

$$Flow_{Total} = Flow_{methane} + (Flow_{methane} \times air_{ratio}) + Flow_{remaining}$$ [6]

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):

$$FE = \frac{(Flow_{methane} \times 0{,}7168) - \frac{M_{methane}}{1000}}{(Flow_{methane} \times 0{,}7168)} \times 100$$

BIOAGRI was hired to make an analysis of methane concentration in the exhaust gas in 11/10/2007. The results were:

Flare	October/2007
F520	5,19 mg/Nm^3
F540	4,51 mg/Nm^3
F560	4,33 mg/Nm^3

To calculate the flare efficiency, the following monitoring data was used.

Measurement	$Flow_{FIR500}$			$\%_{methane}$		
	F520	F540	F560	F520	F540	F560
October/2007	5.000 Nm^3/h	4.892 Nm^3/h	4.750 Nm^3/h	54,2%	54,6%	55,5%

Data were registered at the Operation Diary.

The results were:

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

Measurement	Flare Efficiency Calculated		
	F520	F540	F560
October/2007	99,9950%	99,9957%	99,9959%

The flare efficiency adopted for the whole monitoring period is 99,9950% (the lowest efficiency calculated).

4.2. Description and consideration of measurement uncertainties and error propagation:

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

$$\varepsilon = \sqrt{(\text{Gas flow normalized})^2 + (\text{Pressure transmitter})^2 + (\text{Temperature transmitter})^2 + (\text{Gas analysis})^2}$$

Applying the formula above to the flow-meter FIR500:

$$\varepsilon = \sqrt{(0{,}9800)^2 + (0{,}0100)^2 + (0{,}0300)^2 + (1{,}0000)^2} = 1{,}4005\%$$

4.3. GHG emission reductions

Using the table from item 2.2.3 and the step-by-step calculation of item 4.1, the final result is:

	TOTAL
Total CO_2e from methane destroyed in flares	124.101
Total CO_2e from electricity consumption	106
TOTAL CO_2e	**123.995**

ARCADIS Tetraplan S.A.

Av. Nove de Julho, 5966, térreo,
Jardim Paulista, São Paulo-SP
CEP 01406-200

Fone/fax: +55 (11) 3060 8457
E-mail: tetraplan@tetraplan.com.br

Website: www.tetraplan.com.br
www.arcadis-global.com