ARCADIS TETRAPLAN

Imagine the Result

São João Landfill Gas to Energy Project (SJ)

Monitoring Report – Version 01
2nd Verification
Monitoring Period: 01/07/2007 to 31/10/2007

São Paulo, November 7th, 2007

Clean Development Mechanism

Monitoring Report – Version 01

São João Landfill Gas to Energy Project (SJ)

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Biogás Energia Ambiental SA

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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

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 1st 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.

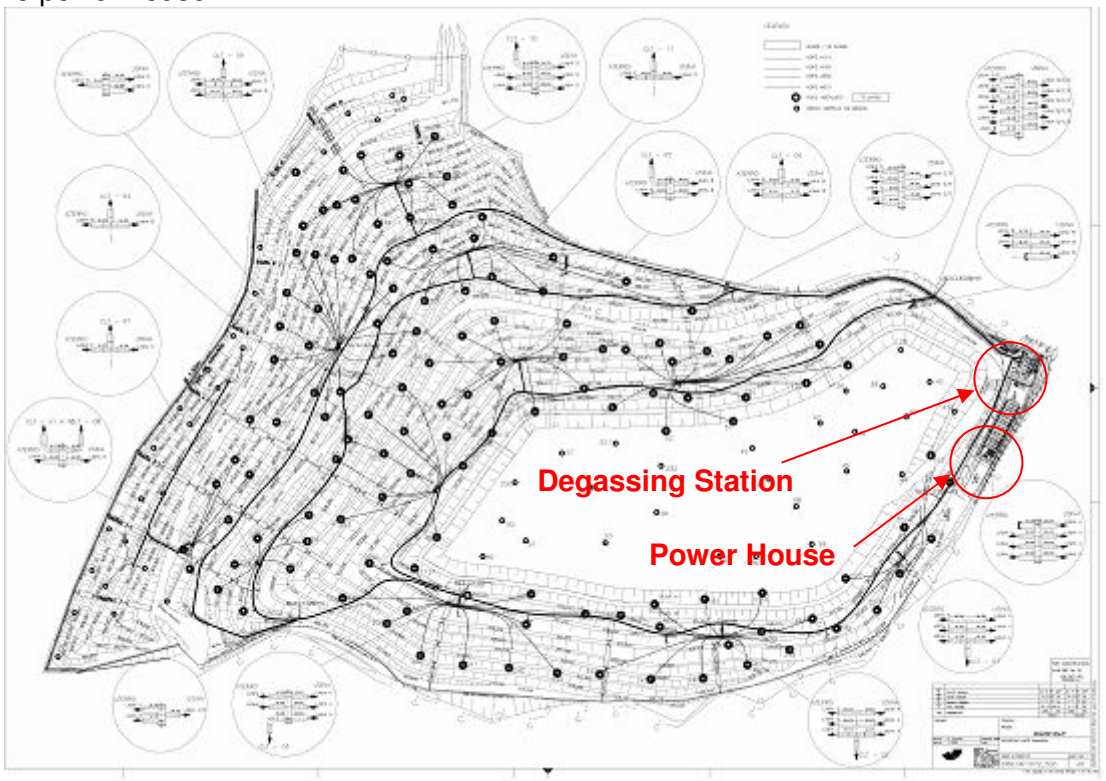

Figure 1.1: SJ Lay-out

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 two 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). Data recorded from FIR500 and FIR600 will replace the date recorded from the thermal mass-flow-meters previously installed during the 1st Verification and a new flare (tag F560) was installed.

While the power house has not been installed, SJ will generate 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).

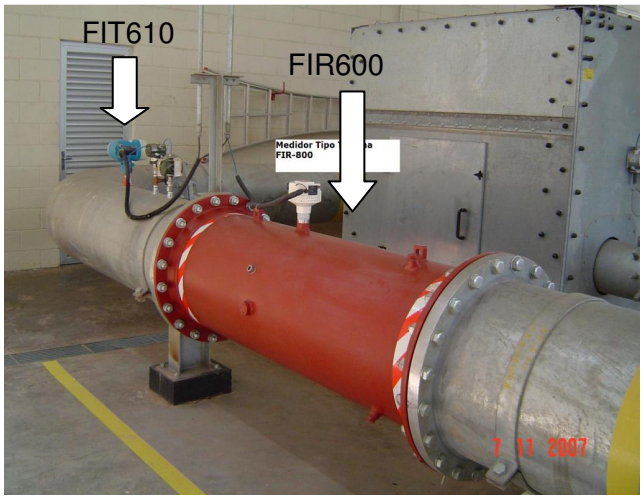

Figure 1.8: FIR600 and FIT610

Figure 1.9: FIR500 and FIR800

Figure 1.10: Flares F520 and F540

Figure 1.11: Flare F560

Figure 1.12: Blower

Figure 1.13: Detail of the blower

Figure 1.14: Future location of the chiller

Figure 1.15: Methane Analyser A400

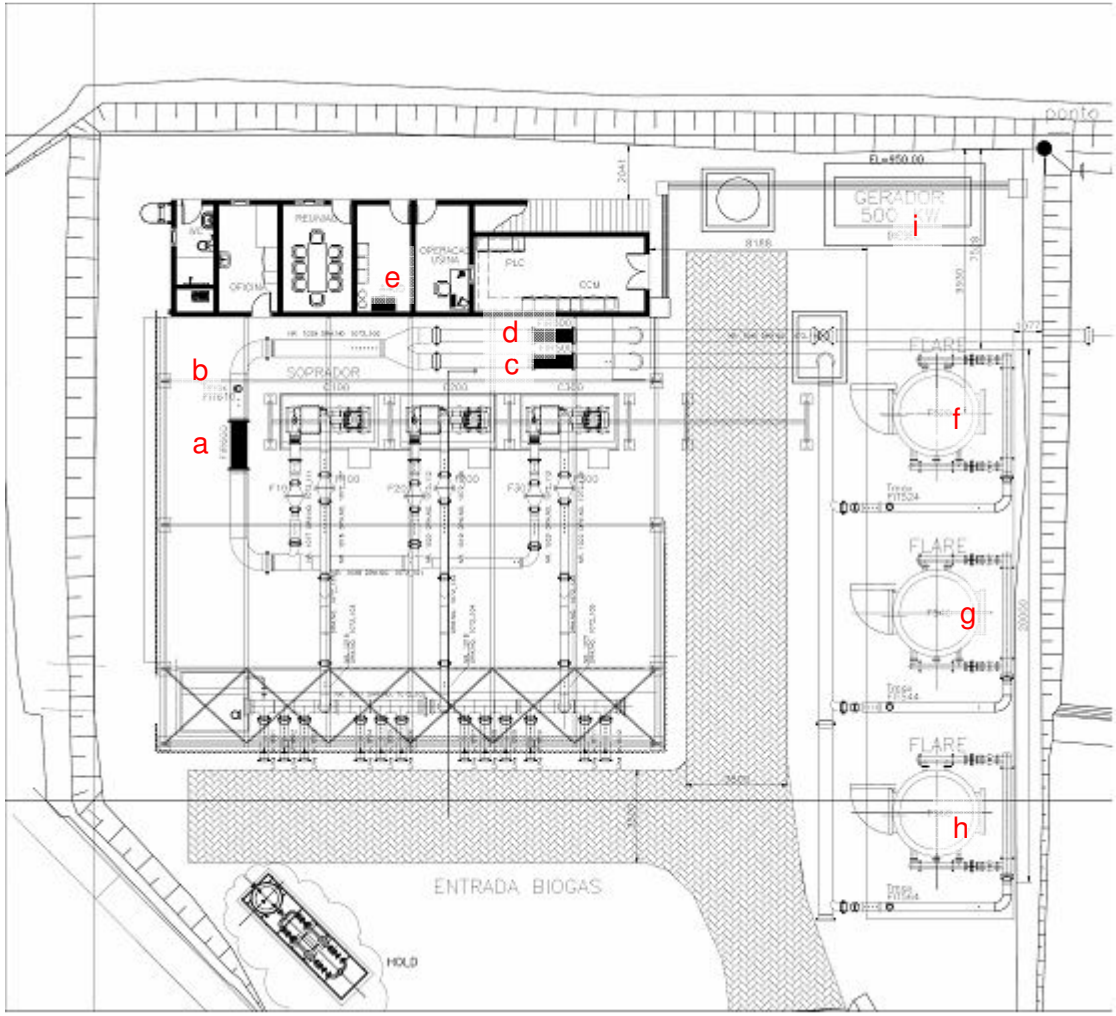

Figure 1.16: Lay-out of the Degassing Station

a) FIR600 – Turbine Flow-meter **(installed in 02/07/2007 and connected to the PLC on 12/07/2007)**
b) FIT610 – Mass-meter
c) FIR500 – Turbine Flow-meter **(installed in 02/07/2007 and connected to the PLC on 12/07/2007)**
d) FIR800 – Turbine Flow-meter **(installed in 02/07/2007 and connected to the PLC on 12/07/2007)**
e) A400 – Methane Analyzer
f) F520 – Flare
g) F540 – Flare
h) F560 – Flare **(installed in 24/07/2007)**
i) Diesel Electricity Generator

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 1.17: Screen of the PLC

1.4. Changes against the PDD

For this 1st Verification, the following changes are 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 01/07/2007 to 31/10/2007.

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:

The main changes since the 1st Verification were:

- installation of the turbine flow-meters FIR500, FIR600 and FIR700;
- installation of a new flare (tag F560);

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

This monitoring report was developed and revised by:

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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)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow	Turbine Flow-meter	Instromet	SM-RI X K	1,2800
Temperature	Temperature Transmitter	Yokogawa	YTA110	0,1000
Pressure	Pressure Transmitter	Yokogawa	EAJ510A	0,0100

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 X K	0,4800
Temperature	Temperature Transmitter	Yokogawa	YTA110	0,0200
Pressure	Pressure Transmitter	Yokogawa	EAJ510A	0,0300

3 – Flow-meter FIT610 (Total Gas Collected)

Variable	Type of Equipment	Manufacturer	Model	Error (+/- %)
Gas Flow (in Nm^3/h)	Thermal Mass Flow-Meter	Endress & Hauser	65I-40AA0AD1AAABAB	5,0000%

4 – Methane Analyzer A400

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

5 – Exhaust Gas Methane Concentration

Analysis made by specialized company.

2.1.2. Involvement of Third Parties:

For this 1st Verification SJ has 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 TASQA, a national and certified laboratory, to develop the analysis.

Also, another other party is involved (indirectly) to 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.

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/m^3
Emission Factor of Diesel Engines = 0,9 tCO_2e/MWh[1]

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. Data concerning GHG emissions by sources of the project activity:

During the 1st verification period, SJ had one source of project emissions: electricity consumed from diesel engines, as presented in the table below.

DATE	Electricity consumed from the diesel engines (MWh)
01/07/2007	0,3654
02/07/2007	0,3158
03/07/2007	0,3665
04/07/2007	0,4521
05/07/2007	0,5662
06/07/2007	0,5698
07/07/2007	0,6012
08/07/2007	0,6101
09/07/2007	0,6022
10/07/2007	0,6235
11/07/2007	0,6201

[1] Emisison factor recommended from IPCC's Inventory Guidelines, 1996

DATE	Electricity consumed from the diesel engines (MWh)
12/07/2007	0,6652
13/07/2007	0,6301
14/07/2007	0,6221
15/07/2007	0,6213
16/07/2007	0,6221
17/07/2007	0,6074
18/07/2007	0,6109
19/07/2007	0,6310
20/07/2007	0,6301
21/07/2007	0,6212
22/07/2007	0,6322
23/07/2007	0,6201
24/07/2007	0,6211
25/07/2007	0,6088
26/07/2007	0,6307
27/07/2007	0,6285
28/07/2007	0,6290
29/07/2007	0,6241
30/07/2007	0,6899
31/07/2007	0,9744
01/08/2007	1,4154
02/08/2007	1,4022
03/08/2007	1,4089
04/08/2007	1,4711
05/08/2007	1,4779
06/08/2007	0,7391
07/08/2007	1,4639
08/08/2007	1,4180
09/08/2007	1,4548
10/08/2007	1,4352
11/08/2007	1,4293
12/08/2007	1,4360
13/08/2007	0,4210
14/08/2007	0,6810
15/08/2007	0,7484
16/08/2007	0,7537
17/08/2007	0,7368
18/08/2007	0,7393
19/08/2007	0,7524
20/08/2007	0,7707
21/08/2007	0,8416

DATE	Electricity consumed from the diesel engines (MWh)
22/08/2007	0,9090
23/08/2007	1,0174
24/08/2007	1,0570
25/08/2007	1,0625
26/08/2007	1,0172
27/08/2007	1,0854
28/08/2007	1,0137
29/08/2007	1,0088
30/08/2007	1,0110
31/08/2007	1,0000
01/09/2007	1,1220
02/09/2007	1,1774
03/09/2007	1,2113
04/09/2007	1,2240
05/09/2007	1,2005
06/09/2007	1,1424
07/09/2007	0,8991
08/09/2007	1,2433
09/09/2007	1,2808
10/09/2007	1,2990
11/09/2007	1,2845
12/09/2007	1,1709
13/09/2007	1,3218
14/09/2007	1,4502
15/09/2007	1,4170
16/09/2007	1,3558
17/09/2007	1,3669
18/09/2007	1,4632
19/09/2007	1,5794
20/09/2007	1,6116
21/09/2007	1,5447
22/09/2007	1,5463
23/09/2007	1,5516
24/09/2007	1,4543
25/09/2007	1,5212
26/09/2007	1,4812
27/09/2007	1,5590
28/09/2007	1,5193
29/09/2007	1,4685
30/09/2007	1,4627
01/10/2007	1,4864

DATE	Electricity consumed from the diesel engines (MWh)
02/10/2007	1,4886
03/10/2007	1,4767
04/10/2007	1,3771
05/10/2007	1,4970
06/10/2007	1,4289
07/10/2007	1,4354
08/10/2007	1,4984
09/10/2007	1,5383
10/10/2007	1,7701
11/10/2007	1,8433
12/10/2007	1,7700
13/10/2007	1,7571
14/10/2007	1,6059
15/10/2007	1,1054
16/10/2007	1,4468
17/10/2007	1,7658
18/10/2007	1,7549
19/10/2007	1,8762
20/10/2007	1,8148
21/10/2007	1,8801
22/10/2007	1,9128
23/10/2007	1,8947
24/10/2007	1,6292
25/10/2007	1,8193
26/10/2007	1,8429
27/10/2007	1,4100
28/10/2007	1,2246
29/10/2007	1,8323
30/10/2007	1,8406
31/10/2007	1,8653

2.2.4. Data concerning GHG emissions by sources of the baseline:

The following table presents the collected data from the period 01/07/2007 to 31/10/2007. The table is divided in two parts:

Part a) From 01/07/2007 to 11/07/2007

During this period, the monitoring of gas sent to the flares was made using the readings from the thermal-mass flow-meter FIT610.

DAY	COLLECTING SYSTEM			FLARING SYSTEM	
	LFG Collected (Nm^3)	Methane (%)	Methane Collected (Nm^3)	Flaring System Efficiency (%)	Total Methane Destroyed (Nm^3)
01/07/2007	228.430,7344	60,4542	138.095,9730	99,9999%	138.095,8349
02/07/2007	159.647,2344	60,1000	95.947,9878	99,9999%	95.947,8918
03/07/2007	213.460,0625	59,1292	126.217,2272	99,9999%	126.217,1009
04/07/2007	214.632,4219	58,8250	126.257,5221	99,9999%	126.257,3958
05/07/2007	240.118,2252	57,8458	138.898,3083	99,9999%	138.898,1694
06/07/2007	220.069,6719	57,6625	126.897,6745	99,9999%	126.897,5476
07/07/2007	230.128,2031	57,1875	131.604,5661	99,9999%	131.604,4344
08/07/2007	230.102,2188	57,2500	131.733,5202	99,9999%	131.733,3884
09/07/2007	229.370,9688	57,2583	131.333,9174	99,9999%	131.333,7860
10/07/2007	229.718,1875	57,1292	131.236,1627	99,9999%	131.236,0314
11/07/2007	225.960,5938	57,4917	129.908,5867	99,9999%	129.908,4567

Part b) From 12/07/2007 to 31/10/2007

During this period, the monitoring of gas sent to the flares was made using the readings from the turbine flow-meters FIR500, FIR600 and FIR800.

DAY	COLLECTING SYSTEM			FLARING SYSTEM			
	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)
12/07/2007	225.046,3281	57,9167	130.339,4067	224.780,7188	130.185,5745	99,9999%	130.185,4443
13/07/2007	220.129,6563	58,2333	128.188,7631	219.732,9688	127.957,7589	99,9999%	127.957,6309
14/07/2007	223.555,9844	57,6625	128.907,9695	223.181,5156	128.692,0414	99,9999%	128.691,9127
15/07/2007	224.388,3125	57,1500	128.237,9205	223.965,8594	127.996,4886	99,9999%	127.996,3606
16/07/2007	225.993,7969	58,1083	131.321,1534	225.594,7969	131.089,3013	99,9999%	131.089,1702
17/07/2007	225.600,7813	58,6333	132.277,1829	225.218,1406	132.052,8280	99,9999%	132.052,6959
18/07/2007	222.075,8281	58,0500	128.915,0182	221.981,7500	128.860,4058	99,9999%	128.860,2769
19/07/2007	214.574,4375	59,2500	127.135,3542	214.846,8438	127.296,7549	99,9999%	127.296,6276
20/07/2007	224.389,3125	59,2750	133.006,7649	225.157,4063	133.462,0525	99,9999%	133.461,9190
21/07/2007	169.049,5156	59,6250	100.795,7736	169.499,8906	101.064,3097	99,9999%	101.064,2086
22/07/2007	222.244,7188	57,8375	128.540,7892	223.053,8438	129.008,7669	99,9999%	129.008,6378
23/07/2007	149.654,8438	57,6833	86.325,8525	149.807,1875	86.413,7293	99,9999%	86.413,6428
24/07/2007	211.693,8750	59,2375	125.402,1592	212.262,9844	125.739,2853	99,9999%	125.739,1595
25/07/2007	221.996,4688	59,3167	131.680,9794	222.508,5156	131.984,7086	99,9999%	131.984,5766
26/07/2007	260.622,5938	55,3542	144.265,5518	261.667,4375	144.843,9166	99,9999%	144.843,7717
27/07/2007	288.777,5313	56,2083	162.316,9411	290.098,2813	163.059,3122	99,9999%	163.059,1491
28/07/2007	319.113,9688	54,8333	174.980,7198	320.517,7813	175.750,4765	99,9999%	175.750,3007
29/07/2007	319.326,0625	54,8375	175.110,4295	320.941,0000	175.996,0208	99,9999%	175.995,8448
30/07/2007	302.232,1875	56,4417	170.584,9845	303.829,2500	171.486,3937	99,9999%	171.486,2222
31/07/2007	305.796,6563	54,3833	166.302,3129	306.725,0625	166.807,2109	99,9999%	166.807,0440
01/08/2007	319.262,5000	56,3000	179.744,7875	319.498,4688	179.877,6379	99,9999%	179.877,4580
02/08/2007	318.350,4063	55,2250	175.809,0118	318.561,6250	175.925,6574	99,9999%	175.925,4814
03/08/2007	315.834,1875	54,9792	173.643,1096	315.966,1875	173.715,6821	99,9999%	173.715,5083
04/08/2007	318.188,8750	56,1917	178.795,7380	318.328,2500	178.874,0552	99,9999%	178.873,8763

DAY	COLLECTING SYSTEM			FLARING SYSTEM			
	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)
05/08/2007	321.504,9375	56,0083	180.069,4499	321.605,6875	180.125,8782	99,9999%	180.125,6980
06/08/2007	161.136,8438	58,4667	94.211,3950	160.987,3594	94.123,9964	99,9999%	94.123,9022
07/08/2007	316.773,5625	57,4083	181.854,3170	316.803,3438	181.871,4140	99,9999%	181.871,2321
08/08/2007	312.376,9063	57,7583	180.423,5906	312.328,5313	180.395,6500	99,9999%	180.395,4696
09/08/2007	318.676,9063	57,7250	183.956,2441	318.656,3750	183.944,3924	99,9999%	183.944,2084
10/08/2007	316.340,1250	57,3583	181.447,3179	316.299,7813	181.424,1774	99,9999%	181.423,9959
11/08/2007	320.536,8750	57,0042	182.719,4812	320.488,3438	182.691,8164	99,9999%	182.691,6337
12/08/2007	320.631,5938	57,2958	183.708,4367	320.571,1563	183.673,8085	99,9999%	183.673,6248
13/08/2007	89.702,0000	48,4875	43.494,2572	89.206,8984	43.254,1948	99,9999%	43.254,1515
14/08/2007	138.671,1094	58,2083	80.718,0953	137.957,0000	80.302,4244	99,9999%	80.302,3440
15/08/2007	153.225,5625	58,0917	89.011,3340	152.642,0156	88.672,3417	99,9999%	88.672,2530
16/08/2007	156.046,3594	57,9250	90.389,8536	155.313,4219	89.965,2996	99,9999%	89.965,2096
17/08/2007	152.949,9531	58,2667	89.118,8903	152.106,8750	88.627,6565	99,9999%	88.627,5678
18/08/2007	153.147,6250	58,9333	90.254,9492	152.243,0156	89.721,8331	99,9999%	89.721,7433
19/08/2007	157.582,2969	58,9458	92.888,1455	156.664,5469	92.347,1704	99,9999%	92.347,0780
20/08/2007	151.618,7500	58,2542	88.324,2898	150.733,3906	87.808,5308	99,9999%	87.808,4429
21/08/2007	163.801,4219	58,5167	95.851,1866	162.850,1250	95.294,5190	99,9999%	95.294,4237
22/08/2007	172.541,5469	58,7417	101.353,8378	171.555,0781	100.774,3693	99,9999%	100.774,2685
23/08/2007	186.797,1563	58,2000	108.715,9449	185.798,6875	108.134,8361	99,9999%	108.134,7279
24/08/2007	192.155,2500	57,1750	109.864,7641	191.156,4063	109.293,6753	99,9999%	109.293,5660
25/08/2007	193.467,4219	56,6458	109.591,1688	192.459,0313	109.019,9579	99,9999%	109.019,8488
26/08/2007	192.637,9498	56,0333	107.941,4003	191.558,0343	107.336,2880	99,9999%	107.336,1806
27/08/2007	189.629,3750	55,8833	105.971,1525	188.509,2500	105.345,1897	99,9999%	105.345,0843
28/08/2007	189.708,0625	57,1500	108.418,1577	188.240,1406	107.579,2403	99,9999%	107.579,1327
29/08/2007	188.363,4531	57,8417	108.952,6234	187.100,7656	108.222,2635	99,9999%	108.222,1552
30/08/2007	178.231,5625	58,1080	103.566,7963	177.107,0938	102.913,3900	99,9999%	102.913,2870
31/08/2007	181.759,8906	56,0667	101.906,7725	180.739,2500	101.334,5330	99,9999%	101.334,4316
01/09/2007	204.483,7969	58,0083	118.617,5743	203.445,0000	118.014,9859	99,9999%	118.014,8678
02/09/2007	213.719,2813	57,1542	122.149,5454	212.670,3906	121.550,0603	99,9999%	121.549,9387
03/09/2007	219.539,9844	57,9667	127.260,0841	218.601,1875	126.715,8945	99,9999%	126.715,7677
04/09/2007	222.174,1875	57,4917	127.731,7173	221.386,8594	127.279,0690	99,9999%	127.278,9417
05/09/2007	216.196,4375	57,2958	123.871,4784	215.418,5625	123.425,7887	99,9999%	123.425,6652
06/09/2007	207.793,3594	57,6792	119.853,5473	207.152,6250	119.483,9768	99,9999%	119.483,8573
07/09/2007	166.860,7969	58,0708	96.897,3996	166.343,5000	96.597,0011	99,9999%	96.596,9045
08/09/2007	228.447,4844	56,9375	130.072,2864	227.844,2500	129.728,8198	99,9999%	129.728,6900
09/09/2007	234.089,5000	57,1167	133.704,1974	233.375,0000	133.296,0986	99,9999%	133.295,9653
10/09/2007	236.637,7500	57,0125	134.913,0972	235.972,8594	134.534,0264	99,9999%	134.533,8918
11/09/2007	233.698,0000	56,9625	133.120,2232	233.031,0000	132.740,2833	99,9999%	132.740,1505
12/09/2007	212.095,0469	57,5458	122.051,7914	211.500,2031	121.709,4838	99,9999%	121.709,3620
13/09/2007	238.387,3281	57,5375	137.162,1089	237.755,4531	136.798,5438	99,9999%	136.798,4070
14/09/2007	253.410,6875	56,9167	144.233,0007	252.834,2344	143.904,9026	99,9999%	143.904,7586
15/09/2007	251.039,0781	56,7250	142.401,9170	250.457,3125	142.071,9105	99,9999%	142.071,7684
16/09/2007	245.569,2188	57,0375	140.066,5431	244.929,7969	139.701,8329	99,9999%	139.701,6931

DAY	COLLECTING SYSTEM			FLARING SYSTEM			
	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)
17/09/2007	244.935,0469	57,5167	140.878,5561	244.286,4219	140.505,4884	99,9999%	140.505,3478
18/09/2007	256.770,5469	57,0167	146.402,0924	256.143,7656	146.044,7224	99,9999%	146.044,5763
19/09/2007	270.183,9063	56,3792	152.327,5249	269.645,0625	152.023,7290	99,9999%	152.023,5769
20/09/2007	272.619,1250	55,8542	152.269,2313	272.148,3750	152.006,2976	99,9999%	152.006,1455
21/09/2007	265.981,3125	55,7708	148.339,9058	265.392,7188	148.011,6424	99,9999%	148.011,4943
22/09/2007	272.005,1250	55,9292	152.130,2903	271.434,5938	151.811,1968	99,9999%	151.811,0449
23/09/2007	269.713,4375	55,6000	149.960,6712	269.164,8438	149.655,6531	99,9999%	149.655,5034
24/09/2007	252.803,7969	55,2917	139.779,5169	252.135,6875	139.410,1079	99,9999%	139.409,9684
25/09/2007	270.651,1250	55,3958	149.929,3559	269.880,8438	149.502,6524	99,9999%	149.502,5028
26/09/2007	262.127,5781	56,9913	149.389,9144	261.359,8750	148.952,3904	99,9999%	148.952,2414
27/09/2007	268.269,0938	56,5125	151.605,5716	267.591,8125	151.222,8230	99,9999%	151.222,6717
28/09/2007	267.984,3750	55,6208	149.055,0532	267.326,0313	148.688,8772	99,9999%	148.688,7285
29/09/2007	271.792,5625	55,0625	149.655,7797	271.059,3750	149.252,0683	99,9999%	149.251,9190
30/09/2007	271.401,3438	55,4625	150.525,9703	270.638,4063	150.102,8260	99,9999%	150.102,6758
01/10/2007	269.749,5938	56,2292	151.678,0385	269.023,1563	151.269,5686	99,9999%	151.269,4173
02/10/2007	267.388,1250	55,3609	148.028,4724	266.624,1563	147.605,5325	99,9999%	147.605,3848
03/10/2007	266.153,1250	54,5750	145.253,0679	265.360,6563	144.820,5781	99,9999%	144.820,4332
04/10/2007	246.084,2656	54,9667	135.264,4000	245.468,4219	134.925,8910	99,9999%	134.925,7560
05/10/2007	265.141,3125	54,4125	144.270,0166	264.676,6563	144.017,1856	99,9999%	144.017,0415
06/10/2007	252.692,7500	54,6500	138.096,5878	252.268,3594	137.864,6584	99,9999%	137.864,5205
07/10/2007	252.393,7500	54,1222	136.601,0501	251.962,8906	136.367,8595	99,9999%	136.367,7231
08/10/2007	266.161,4375	54,0696	143.912,4246	265.649,3750	143.635,5544	99,9999%	143.635,4107
09/10/2007	274.169,6875	54,1227	148.388,0374	273.687,9375	148.127,3013	99,9999%	148.127,1531
10/10/2007	303.760,6875	53,1792	161.537,5035	303.513,5938	161.406,1010	99,9999%	161.405,9395
11/10/2007	312.510,1875	53,2292	166.346,6727	312.218,3750	166.191,3432	99,9950%	166.183,0336
12/10/2007	304.135,2188	54,1458	164.676,4473	303.874,7188	164.535,3974	99,9950%	164.527,1706
13/10/2007	302.590,0313	53,7167	162.541,3793	302.324,5625	162.398,7782	99,9950%	162.390,6582
14/10/2007	285.988,3125	53,4818	152.951,6973	285.647,1250	152.769,2240	99,9950%	152.761,5855
15/10/2007	196.047,4063	53,4667	104.820,0785	195.523,7344	104.540,0885	99,9950%	104.534,8614
16/10/2007	264.742,7500	54,8750	145.277,5840	263.431,1563	144.557,8470	99,9950%	144.550,6191
17/10/2007	311.040,5938	54,6542	169.996,7482	309.719,3438	169.274,6295	99,9950%	169.266,1657
18/10/2007	312.649,6875	55,4625	173.403,3329	311.400,2813	172.710,3810	99,9950%	172.701,7454
19/10/2007	318.030,3750	55,3160	175.921,6822	316.796,0625	175.238,9099	99,9950%	175.230,1479
20/10/2007	319.391,7813	55,6917	177.874,7126	318.200,5625	177.211,3026	99,9950%	177.202,4420
21/10/2007	318.571,8438	54,9792	175.148,2511	317.417,2500	174.513,4647	99,9950%	174.504,7390
22/10/2007	321.212,0938	53,7087	172.518,8398	320.087,5313	171.914,8519	99,9950%	171.906,2561
23/10/2007	319.518,7500	53,2391	170.108,9068	318.392,9688	169.509,5510	99,9950%	169.501,0755
24/10/2007	288.557,4375	55,1458	159.127,3073	287.439,5313	158.510,8290	99,9950%	158.502,9034
25/10/2007	318.663,0000	55,3500	176.379,9705	317.541,0938	175.758,9954	99,9950%	175.750,2074
26/10/2007	317.761,1875	55,2917	175.695,5625	316.661,8750	175.087,7339	99,9950%	175.078,9795
27/10/2007	248.972,0781	57,0000	141.914,0845	247.926,4531	141.318,0782	99,9950%	141.311,0122
28/10/2007	229.148,8438	58,9875	135.169,1742	228.487,9688	134.779,3405	99,9950%	134.772,6015
29/10/2007	317.486,0625	55,0792	174.868,7833	317.039,1875	174.622,6481	99,9950%	174.613,9169

DAY	COLLECTING SYSTEM			FLARING SYSTEM			
	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)
30/10/2007	318.723,0938	54,2375	172.867,4379	318.265,3750	172.619,1827	99,9950%	172.610,5517
31/10/2007	315.916,9375	54,1565	171.089,5562	315.492,6875	170.859,7973	99,9950%	170.851,2543

2.2.5. 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

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:* PMC 41 *Range:* -400 to 400 mbar	**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).	The manometer was delivered calibrated (May/2007)
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 3 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 *Location:* Exit Collector *TAG:* TT 605 *Manufacturer:* E+H *Model:* TMT 187 *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).	The manometer was delivered calibrated (May/2007)
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 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-X-K *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 manometer was delivered calibrated (June/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)		

d) Total Flow (FIT610)

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: Digital Thermal Mass-meter *Location:* Exit Collector *TAG:* FIT 610 *Manufacturer:* E+H *Model:* 65I-40AA0AD1AAABAB *Range:* 900-20.000 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 manometer was delivered calibrated (June/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) 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-X-K *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 manometer was delivered calibrated (June/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)		

f) 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 manometer was delivered calibrated (May/2007)
Reading Frequency Every 5 minutes **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Transmission Frequency** Every 5 minutes **Responsibility** PLC (continuously) and plant supervisor (monthly)	**Registration Frequency** Every 5 minutes **Responsibility** PLC (continuously) and plant supervisor (monthly)		**Calibration Frequency** Weekly, with a standard gas certified by INMETRO

g) Flare Efficiency

1. Data Reading	2. Data Transmission	3. Data Registration	4. Monitoring Report	5. Equipment Calibration
Equipment: According with APEX-EPA 18 *Location* *Manufacturer* *Model* *Range*	**Equipment:** MS Excel spreadsheet	**Equipment:** MS Excel spreadsheet	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
Reading Frequency Every 3 months **Responsibility** Specialized company on gas analysis	**Transmission Frequency** Every 3 years **Responsibility** Plant supervisor (every 3 months)	**Registration Frequency** Every 3 years **Responsibility** Plant supervisor (every 3 months)		**Calibration Frequency** N/A

3.1.2. Trainings:

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

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
Thermal Mass Flow-Meter FIT610	Degassing Station (totalizer)	Apr/2007	Apr/2012
Turbine flow-meter FIR600	Degassing Station (totalizer)	Jun/2007	Jun/2012
Turbine flow-meter FIR500	Degassing Station (gas to the flares)	Jun/2007	Jun/2012
Turbine flow-meter FIR800	Degassing Station (gas to the power house)	Jun/2007	Jun/2012
Methane Analyzer (Binos 100-CH_4)	Degassing Station	Apr/2007	Weekly

4. Calculation of GHG emission reductions

4.1. Table providing the formulas used:

Part a) From 01/07/2007 to 11/07/2007

Variable	Description
A	Methane sent to Flaring System
B	Flaring System Efficiency
C = A . B	Total methane destroyed in Flaring System
D	FIT610 error
E	Methane Concentration error
F = $\sqrt{D^2 + E^2}$	Total error of FIT610
G = C . (1-F)	**Total methane destroyed corrected at Flaring System**
H = 0,0007168	Density of Methane at the STPC
I = G. H	Total weight of methane destroyed
J = 21	CO_2 equivalency
K = I . J	Total equivalent carbon
L = 20%	Baseline
M = K . (1-L)	**Total Liquid Carbon**
N	Electricity consumed from the diesel generators
O = 0,9 tCO_2/MWh	Diesel CO_2 Emission Factor
P = N . O	**Project Emissions due to the consumption of electricity**
Q = M – P	**TOTAL CREDITS DURING PART a)**

Part b) From 12/07/2007 to 31/10/2007

Variable	Description
A	Methane sent to flaring system, measured by FIR500
B	Flare Efficiency
C = A . B	Total methane destroyed in flares
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**
J = 0,0007168	Density of Methane at the STPC

K = I . J	Total weight of methane destroyed
L = 21	CO_2 equivalency
M = K . L	Total equivalent carbon
N = 20%	Baseline
O = M . (1-N)	**Total Liquid Carbon**
P	Electricity consumed from the diesel generators
Q = 0,9 tCO_2/MWh	Diesel CO_2 Emission Factor
R = P . Q	**Project Emissions due to the consumption of electricity**
S = O – R	**TOTAL CREDITS DURING PART b)**

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

a) Calculate the volume of CH_4 sent to flares F_i ($Flow_{methane}$), measured by the equipment FIT_i:or FIR_i

$$\text{Flow}_{\text{methane}} = \text{Flow}_{\text{FIT}_i} \times \frac{\%_{\text{methane}}}{100}$$

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

$$\text{Flow}_{\text{remaining}} = \text{Flow}_{\text{FIT}_i} - \text{Flow}_{\text{methane}}$$

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

$$\text{Flow}_{\text{Total}} = \text{Flow}_{\text{methane}} + \left(\text{Flow}_{\text{methane}} \times \text{air}_{\text{ratio}}\right) + \text{Flow}_{\text{remaining}}$$

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

$$\text{M}_{\text{methane}} = \text{Flow}_{\text{Total}} \times \frac{\text{CH}_{4,\text{eg}}}{1000}$$

e) Calculate the Flare Efficiency (FE):

$$\text{FE} = \frac{\left(\text{Flow}_{\text{methane}} \times 0{,}714\right) - \frac{\text{M}_{\text{methane}}}{1000}}{\left(\text{Flow}_{\text{methane}} \times 0{,}714\right)} \times 100$$

TASQA was hired to make an analysis in 29/06/2007 and BIOAGRI was hired to make an analysis on 11/10/2007. The results were:

Flare	June/2007	October/2007
F520	< 0,001 mg/Nm^3	5,19 mg/Nm^3
F540	< 0,001 mg/Nm^3	4,51 mg/Nm^3
F560	N/A[2]	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
June/2007	5.145 Nm^3/h	5.047 Nm^3/h	N/A[2]	61,7%	59,9%	N/A[2]
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:

Measurement	Flare Efficiency Calculated		
	F520	F540	F560
June/2007	99,9999%	99,9999%	N/A[2]
October/2007	99,9950%	99,9957%	99,9959%

The calculation of the flare efficiency between 01/07/2007 and 10/10/2007 resulted in a flare efficiency of 100%. A conservative value of 99,9999% (four decimal rounds) was adopted for this period. The flare efficiency adopted from 11/10/2007 on 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):

4.2.1. Part a) From 01/07/2007 to 11/07/2007

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

Using the specific erros from FIT610, as presented in 2.1.1:

$$\varepsilon = \sqrt{(5{,}0000)^2 + (1{,}0000)^2} = 5{,}0991\%$$

[2] By the time of the first flare efficiency analysis, the flare F560 was not installed.

4.2.2. Part b) From 12/07/2007 to 31/10/2007

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

Applying the formula above to the flow-meter FIR500:

$$\varepsilon = \sqrt{(1{,}2800)^2 + (0{,}1000)^2 + (0{,}0100)^2 + (1{,}0000)^2} = 1{,}6275\%$$

4.3. GHG emission reductions

Using the table from items 2.2.4 and 2.2.3, and the step-by-step calculation of item 4.1, the final result is:

	Part a)	**Part b)**	**TOTAL**
Total CO_2e from methane destroyed in flares	16.077	184.984	**201.061**
Total CO_2e from electricity consumption	6	125	**131**
TOTAL CO_2e	**16.071**	**184.859**	**200.930**

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