

MONITORING REPORT



BRAZIL NOVAGERAR LANDFILL GAS TO ENERGY PROJECT

REGISTRATION NUMBER: 0008

CREDITING PERIOD: 01st July 2004 to 30th June 2011

MONITORING PERIOD: 01st January 2008 to 31st December 2008

YEAR OF REFERENCE: 2008

VERSION: 01

DATE: 30/ 01 / 2009

1. GENERAL PROJECT ACTIVITY AND MONITORING INFORMATION

1.1. TITLE AND REGISTRATION NUMBER OF THE PROJECT ACTIVITY

Brazil Novagerar Landfill Gas to Energy Project, registration number: 0008

1.2. INTRODUCTION

NOVAGERAR is the environmental and energy branch created by the *SA Paulista Group*, a Brazilian civil engineering and construction group based in the city of São Paulo, Brazil.

In 2001, *SA Paulista* was granted a 20-year concession (PPP model) by the Nova Iguaçu Municipal Council through its Municipal Waste Management Company (*EMLURB*) a government agency responsible for waste collection and disposal. The object of this concession is to Build and Operate a Waste Treatment and Disposal Plant (including a sanitary landfill – called Adrianópolis) and to close, rehabilitate and recover the existing dump site called Marambaia in Nova Iguaçu city, state of Rio de Janeiro, and to explore the landfill gas potential of these sites. The Marambaia dump site opened in 1986 and ceased operation in feb/2003 with approximately 700 thousand tons of waste deposited. The New Waste Plant (Adrianópolis) started operation in feb/2003 and receives approximately 2.000 tons of waste per day.

In December of 2008 the *Haztec Tecnologia e Planejamento Ambiental SA* has acquired the control of Novagerar. Haztec works in the areas of environmental diagnosis, remediation of impacted areas, climate changes, integrated environmental management and environmental emergency response. The company is controlled by Grupo Synthesis. The fusion and synergy of the companies will allow Haztec entering the promising and growing market of waste treatment, renew energy. With that, the company will provide integrated solutions in all fields of environmental science and corporate sustainability

NOVAGERAR has implemented a landfill gas collection system, to capture and destroy the methane gas and to generate electricity in the Waste Treatment and Disposal Plant ("*Central de Tratamento de Resíduos – Nova Iguaçu - CTR Nova Iguaçu*"), in accordance with the Project Design Document of February 2004, and with the monitoring plan of February 2004 validated in September 2004 for validation report of DNV NB 2003-0221 – version 03 approved for the Brazilian government in June/2004.

1.3. SHORT DESCRIPTION OF THE REAL PROJECT IMPLEMENTATION

The Waste Treatment and Disposal Plant - CTR Nova Iguaçu has a Landfill divided into 4 cells for waste disposal, named Sub-Landfill 1, Sub-Landfill 2, Sub-Landfill 3, and Sub-

Landfill 4. At the end of 2008, the waste disposal was done in only 2 cells (Sub-Aterro 1 and Sub-Aterro 3) and the gas extraction system was operating in the Sub-Aterro 1. Also in November of 2008 the waste disposal has initiated in the Sub-Aterro 4 and the gas extraction system has extended in the in Sub-Aterro 3.



FIGURE 1 – The CTR Nova Iguaçu Landfill

The Adrianópolis and Marambaia sites are adjacent to each other located beside a densely populated section of the municipality of Nova Iguaçu, Rio de Janeiro, with more than 800,000 inhabitants. Because of their location near the city of Rio de Janeiro, many manufacturer companies are either relocating existing facilities or establishing new plants in Nova Iguaçu. The municipality today hosts more than 600 industries and 2,400 commercial establishments. The site is located approximately 10 Kilometers from the center of Nova Iguaçu city. Electrical power transmission lines are located less then 1Km from the site.

The project, in the first step, is to capture and treat (burn in high temperatures), the methane produced by the solid waste anaerobic decomposition in sanitary landfill. Later, the gas will be used to power the electricity engines in the power plant.

The equipments were installed to capture and burn the methane gas with capacity for 3,000 m³/h, allowing for an expansion of up to 9,000 m³/h. This equipment consists of an enclosed flare with controlled burning and the blower system.

This system captures the landfill gas by way of suction in the piping network into the perforated horizontal and vertical well and the Ranzine drains, draining through well-heads, which prevents air flow into the grid and allows for measurements in each well. The gas is analyzed to ascertain its composition, temperature and pressure every 2 minutes. The burning efficiency is automatically adjusted by the system by controlling the air inlet in the burner and registering the temperatures of burn. All data is sent every 4 minutes to the management program which refreshes automatically in the website program. All condensation generated inside the grid is collected and sent to the leachate treatment area.



FIGURE 2 – The Flare and Blower System

1.4. CREDITING PERIOD

The crediting period is from 01st July 2004 to 30th June 2011.

1.5. MONITORING PERIOD

The monitoring period is from 01st January 2008 to 31st December 2008.

1.6. BASELINE METHODOLOGY APPLIED TO THE PROJECT ACTIVITY

The baseline applied to this project activity is AM0003: “Simplified Financial Analysis for Landfill Gas Capture Projects” version 01.

1.7. MONITORING METHODOLOGY APPLIED TO THE PROJECT ACTIVITY

The monitoring methodology applied to this project activity is AM0003: “Simplified Financial Analysis for Landfill Gas Capture Projects” version 01

1.8. PERSONS RESPONSIBLE FOR THE PREPARATION AND SUBMISSION OF THE MONITORING REPORT:

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2. MONITORING PLAN AND ACTIVITIES

Two landfills sites are part of the projects activity, the project has been in operation since 15th March 2007 for CTR Nova Iguaçu and 17th May 2007 for Marambaia.

2.1 MONITORING EQUIPMENTS

The following equipment are used to monitor the operation of the project and to monitor the Emission Reduction, the control of the periodic time for each maintenance and inspection, was defined in Novagerar procedures and monitored by the Automatic Indicator Hours (hour meter).

2.1.1 Flow Meter

The flow meter is used to measure the gas flow channeled to the flare. The manufacturer of this flow meter is Thermal Instrument Company, the periodic calibration is every 18 months.

2.1.2 Gas Analyzer

The gas analyzer is used to measure the gas composition. The manufacturer of the gas analyzer is CES Landtec Inc, the periodic calibration is every 6 months.

2.1.3 Flare

The manufacturer of the flare system is John Zinc Company, the flare system is monitored for each 6 months to indicate the efficient of the destroy methane. The flare temperature are continues monitored by the automatic control system to operate in 1,700 °F.

2.2 INVOLVEMENT OF THIRD PARTIES

The Brazil Novagerar Landfill Gas to Energy Project has two sub contracted parties involved.

TASQA SERVIÇOS ANALÍTICOS LTDA

As the analysis of methane concentration in the exhaust gas is made periodically, Novagerar hired *TASQA Serviços Analíticos Ltda*, a national and certified laboratory to develop the analysis.

CES LANDTEC

LANDTEC is a leading provider of monitoring systems for renewable energy and Green House Gas (GHG) reduction validation. All readings and files of the Novagerar project are being monitored by LANDTEC System Software

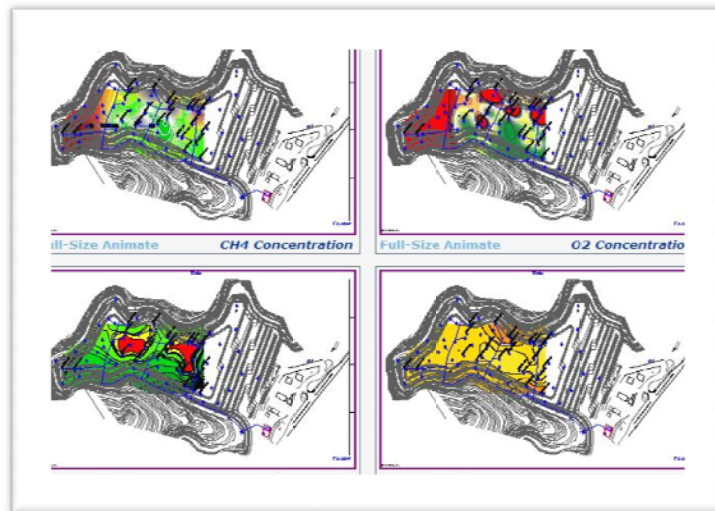


FIGURE 3 – Concentration gas maps for The CTR Nova Iguaçu Landfill

The software (ENVIROCOMP LFG Pro) analyses the maps of each important component to determine how the landfill is producing, if the collection system have escapes and if there is something to improve in the operation.

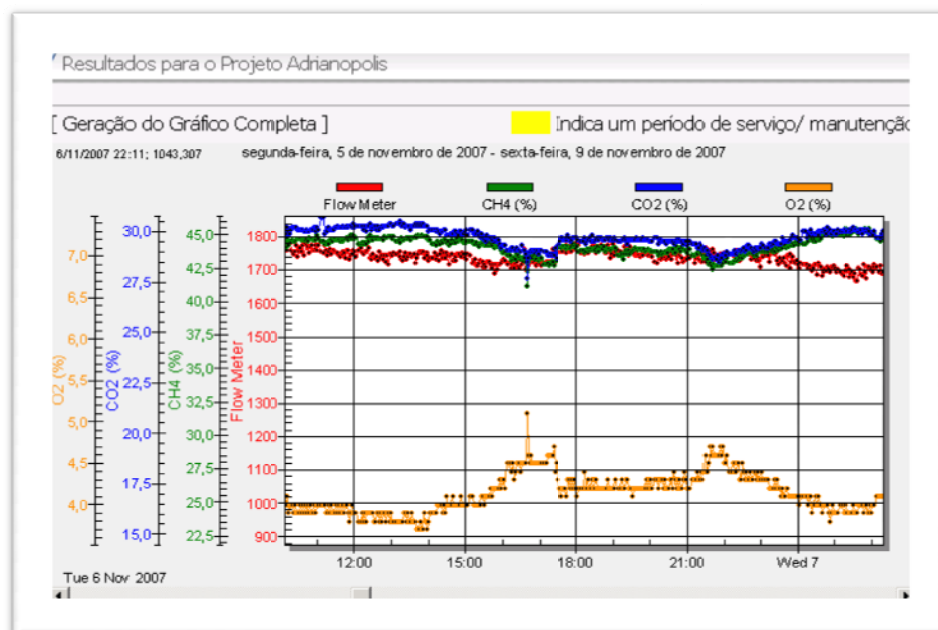


FIGURE 4 – Graphic of the gas composition and flow

The ENVIROCOMP provide in graphics the historical and on-line information of what is happening on the system, in the graph shows the trends and variations on the operational parameter and readings of the percentage of Methane, Flow, Temperature and others.

Also the software can show the readings of any variable of the process in real time, and has the possibility of making the reports of the readings in any historical time.

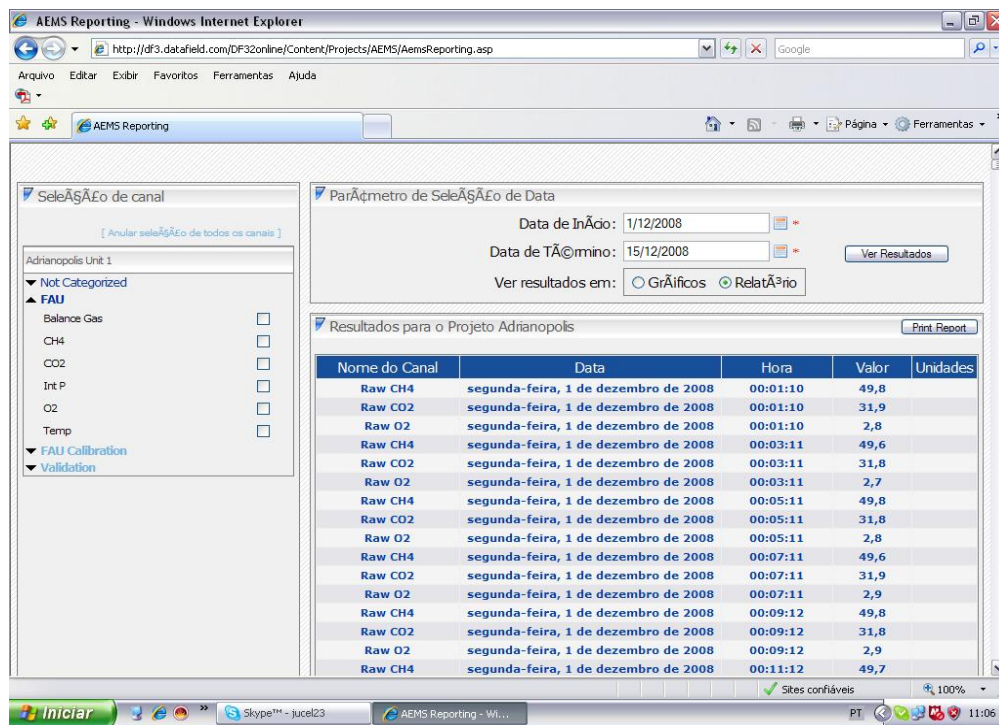


FIGURE 5 – The historical report of the gas composition and flow

2.3 Data Collection

2.3.1 List of fixed default values:

- Global Warming Potential of CH₄ (GWPC_{CH4}) = 21 (tCO₂e/tCH₄);
- Density of Methane = 0.00067899 (tCH₄/m³ CH₄);
- Carbon Emission Factor of LPG (EFLPG) = 17.20 (tC/TJ);
- Fraction of carbon oxidized of LPG = 0.995 ;
- Conversion factor of C to CO₂ = 44/12 = 3.67 (CO₂/C);
- Units Conversion = 9.484 x 10⁻¹⁶ (TJ/BTU);

2.3.2 List of variables:

- $Q_{\text{biogas, flares}}$ = amount of biogas sent to flare (Nm^3);
- % CH₄ = percentage of methane in the biogas (% volume);
- FE = Flare Efficiency % (calculated using data from methane sent to flares and methane content in the exhaust gas, monitored by temperature);
- Emission Factor of the regional Brazilian Grid (EF) - ($\text{tCO}_2\text{e/MWh}$);
- Electrical energy used (kW);
- LPG consumption (number of ignitions)
- Adjustment Factor (AF) = 0.2 (restricted for Marambaia);

2.3.3 Data concerning GHG emissions of the project activity:

The Brazil Novagerar Landfill Gas Energy Project consumes electrical energy from the grid and uses fossil fuel (LPG – Liquefied Petroleum Gas) for the ignition of the flare system. These emissions are being monitored.

The calculation of the LPG, consumed in the flare system, is according to the instructions extracted of the 1996 IPCC Guidelines for national Greenhouse Gas Inventories: Reference Manual - Energy, to determine the emissions for only one ignition in the flare system, in tCO_2e . The number of ignitions is determined by the PLC (programmable logical controller), it is programmed to count each time that an ignition occurs, and stores the value in the database (Envirocomp) in the Landtec server. It is made by counting how many times the solenoid valve (SV-303 Pilot Gas) opened in the month. The total of LPG emission is then determined by the multiplication of Number of ignitions and Emissions for the Ignition, and can be resumed in this expression:

$$\text{Total of LPG Emission} = F_{\text{ox}} * F_{\text{ec}} * F_{\text{tCO}_2/\text{tC}} * \text{FTJ/BTU} * \Phi * \xi * \sigma \text{ (tCO}_2\text{e)}$$

This process was been audited in the First Verification of the Novagerar process, and can be described in the following table.

<i>SYMBOL</i>	F_{ox}	F_{ec}	$F_{tCO_2/tC}$	$F_{TJ/BTU}$	Φ	ξ	σ
VARIABLES NAME	Fraction Carbon Oxidized (%)	Carbon Emission Factor (tC/TJ)	Conversion Factor (tCO ₂ /tC)	Units Conversion TJ/BTU	Ignition Heat (BTU/hr)	Ignition Time (hr)	Number of ignitions in the Month
VALUE	0.995	17.2	3.6667	9.484E-16	6.6257E-8	0.033333	Variable
SOURCE	Fraction Carbon Oxidised- 1996 IPCC Guidelines for national Greenhouse Gas Inventories: Reference Manual - Energy	Carbon Emission Factor - 1996 IPCC Guidelines for national Greenhouse Gas Inventories: Reference Manual - Energy	Periodic Table: [44/12= 3.6667] Atomic Mass of the “CO ₂ ” (44) divided by the Atomic Mass of the “C” (12)	Handbook of Engineering Formulas - Heat and Mass Transfer, GIECK, 2001	Ignition Heat - Fixed default Variable of the Project (John Zinc)	Ignition Time - Fixed default Variable of the Project (John Zinc)	Monthly Data storied in the Envirocomp System

Table 1 – LPG variables

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:

I) METHANE CONCENTRATION:



Equipment:
Methane Analyzer
Location:
Field Analytical Unit
Manufacturer:
Landtec
Model:
FAU
Range:
0-100%
Reading Frequency:
Every 2 minutes
Responsibility:
PLC (continuously) and AEMS _
Automatic Extraction
Monitoring System (CES
Landtec)

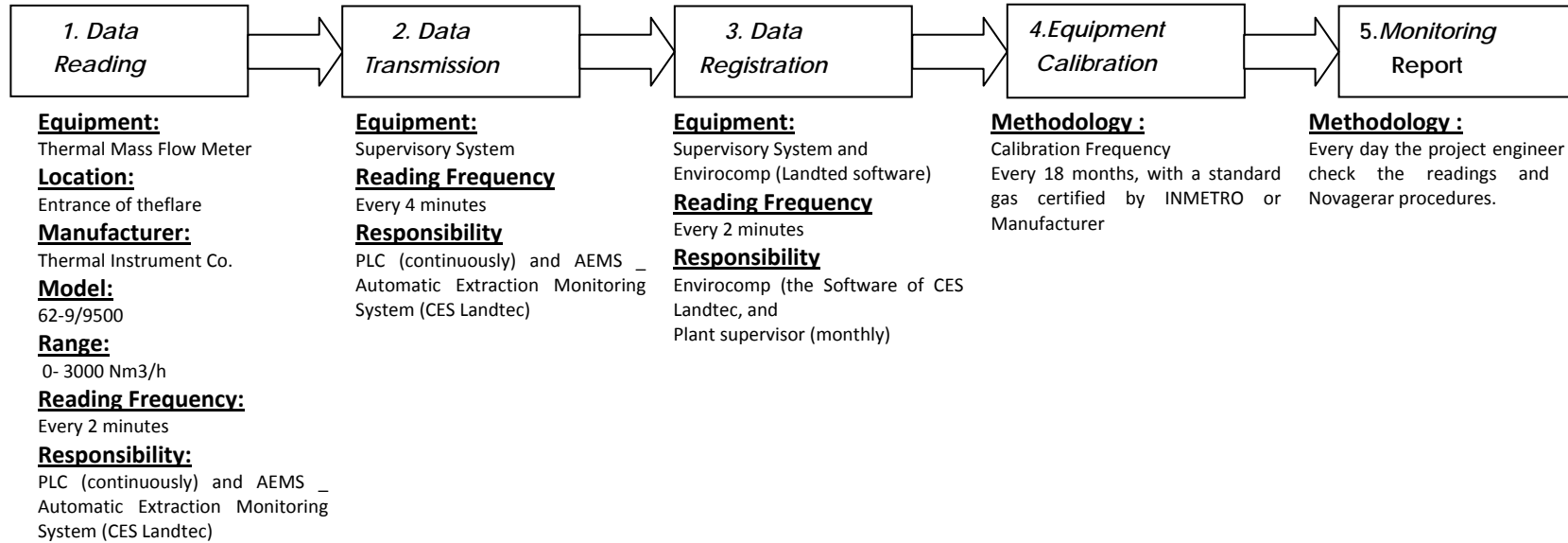
Equipment:
Supervisory System
Reading Frequency:
Every 4 minutes
Responsibility
PLC (continuously) and
AEMS _ Automatic
Extraction Monitoring
System (CES Landtec)

Equipment:
Supervisory System and
Envirocomp (Landted
software)
Reading Frequency
Every 2 minutes
Responsibility
Envirocomp (the Software
of CES Landtec, and
Plant supervisor
(monthly)

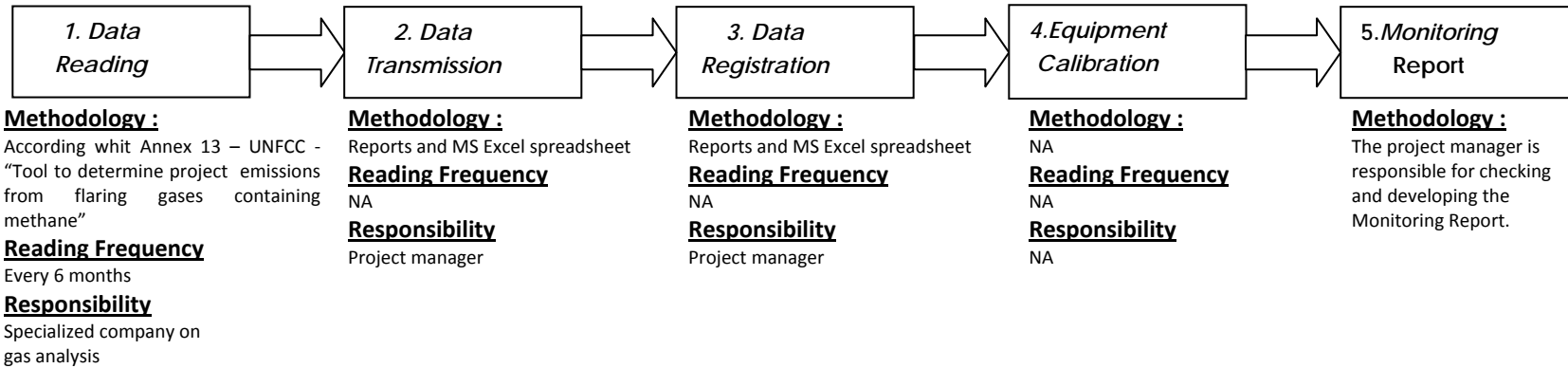
Methodology :
Calibration Frequency
Every hour for automatic field
calibration and every 6 months,
with a standard gas certified by
INMETRO or Manufacturer

Methodology :
Every day the project
engineer will check
the calibration
readings and the
Novagerar
procedures.

II) FLOW TO FLARE:



III) FLARE EFFICIENCY:



3.2. Trainings:

All training was performed prior to the project’s implementation and certified at the initial verification

3.3. Collect data:

The data collected in the monitoring process is summarized in table below as per the monitoring procedure AM0003 approved by the CDM executive board.

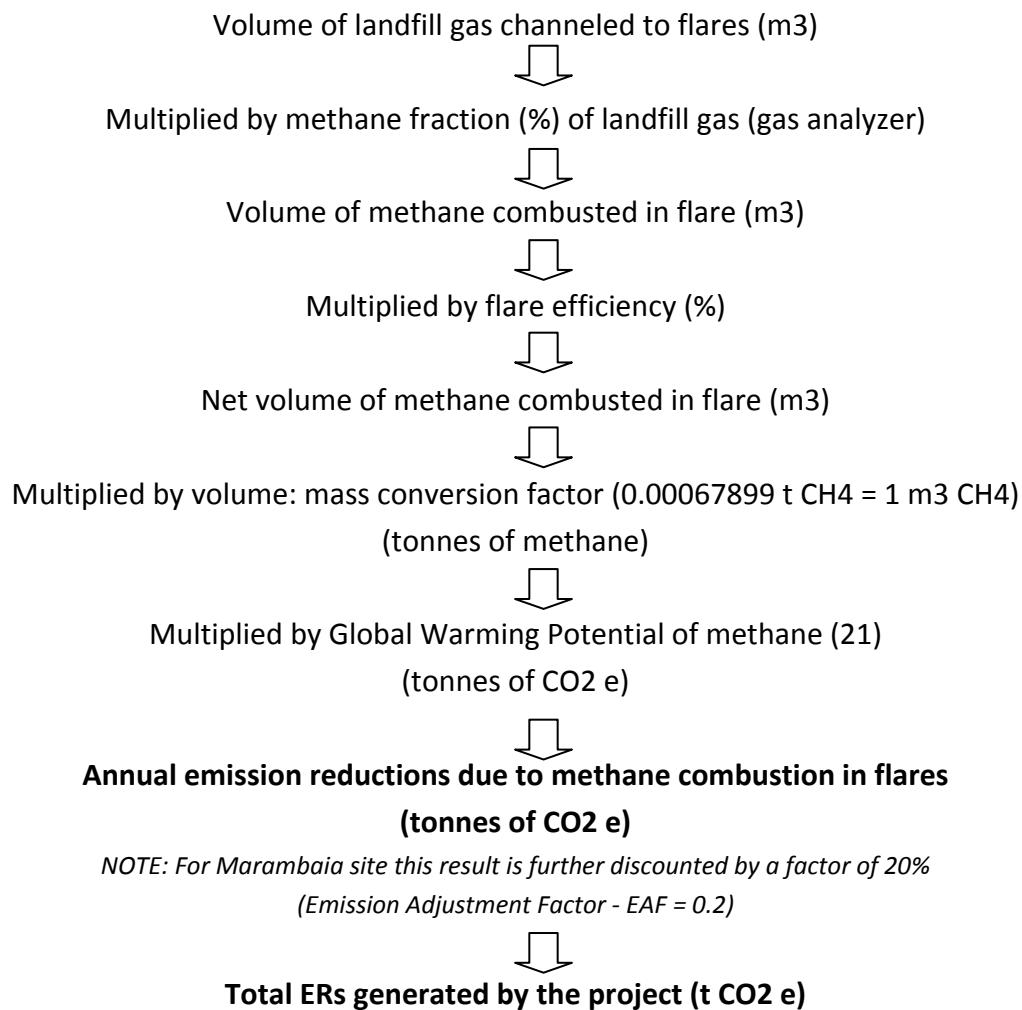
<i>Data Variable</i>	<i>Data Unit</i>	<i>Measured (M), Calculated (C); Estimated (E)</i>	<i>Recording Frequency</i>	<i>Proportion of data to be monitored</i>	<i>How will the data be archived? (electronic/paper)</i>	<i>For how long is archived data to be kept?</i>	<i>Comments</i>
Flow of LFG to flare	m3	M	Continuous	100%	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	Data will be aggregated monthly and yearly
Electricity Imported the Grid	KWh	M&C	Continuous	100%	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	Data will be aggregated monthly and yearly
Flare efficiency	%	M&C	Semi-annual determination of flare efficiency (if significant variation, monthly)	Semi-annual determination of flare efficiency (if significant variation, monthly)	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	Data will be used to test and, if necessary correct the generators standard heat rate plate ratings
Methane Fraction of LFG	%	M&C	Continuous	100%	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	Data will be aggregated monthly and yearly
LPG for ignitions	m3	M&C	Continuous	100%	Electronic (spreadsheet)	2 years and duration of the project crediting period in files	Data will be aggregated monthly and yearly

Table 2 – Collect data

4. CALCULATION OF GHG EMISSION REDUCTIONS

4.1. Calculation Method of ERs

This method can be summarized in these following flowcharts:



For conservative calculation, if the flare temperature is lower than 1,400 °F, the value of the Emission Reduction will be calculated with value zero (ER = 0).

4.2. Calculation Method of Project Emissions

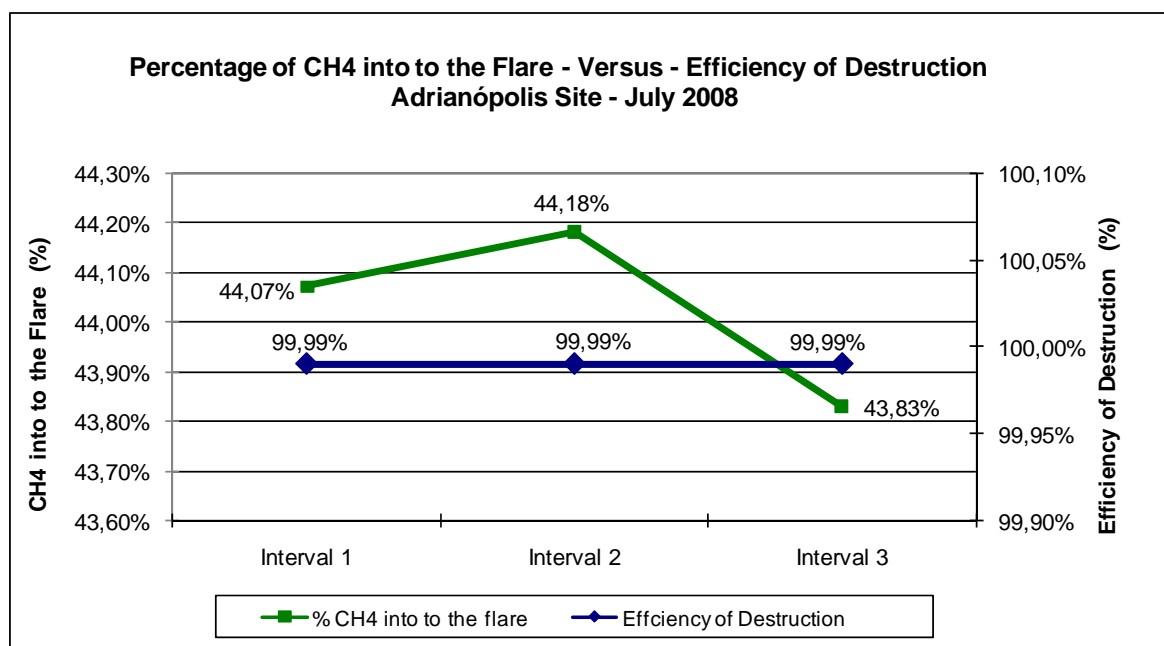
The calculation of methodology applied to this project is:

Version 01 – “Methodological Tool to determine project emissions from flaring gases containing methane”

4.3. Variables Monitored of the Project

4.3.1. Flare Efficiency

The flare efficiency from 01st January, 2008 to 30th June, 2008, was calculated using TASQA’s analysis made on July 2008, and the flare efficiency from 1st July 2008 to 31st December 2009 was calculated using TASQA’s analysis made on January 2009.



Graphic 1 – Flare efficiency and concentration of methane in exhaust gas – Adrianópolis Site

This graphic shows the flare efficiency (Blue line) and the concentration of methane (Green line) in exhaust gas, measured in the normal and operation conditionals in the Adrianópolis Site, this analysis is made in July of 2008.

The following tables shows the collected data, from the period 1st January to 31st December 2008 in the Adrianopolis and Marambaia site.

4.3.2. Data Monitored for Adrianopolis Site

The table bellow shows the monthly readings for the Adrianopolis Site.


		Variables Monitored for Adrianopolis Site Reference Year - 2008			
Reference Month / Year	Amount of LFG send to Flare (m3)	Methane average fraction (%)	Flare Efficiency (%)	Electric Energy Consumption (kWh)	Amount of LPG used (m3)
January / 2008	1.238.210,60	42,71	99,99%	2.615,00	1,59099E-07
February / 2008	1.142.561,25	41,75	99,99%	2.171,00	7,95496E-08
March / 2008	1.120.709,37	42,62	99,99%	2.636,00	6,36397E-08
April / 2008	1.015.898,70	41,94	99,99%	2.024,00	1,75009E-07
May / 2008	1.051.555,80	39,56	99,99%	2.530,00	1,59099E-08
June / 2008	957.639,45	38,85	99,99%	1.468,00	2,22739E-07
July / 2008	1.104.040,89	40,14	99,99%	1.681,00	1,90919E-07
August / 2008	994.401,32	41,96	99,99%	2.095,00	3,18198E-08
September / 2008	830.182,84	45,10	99,99%	1.556,00	1,27279E-07
October / 2008	1.117.992,55	46,87	99,99%	2.471,00	6,36397E-08
November / 2008	1.194.498,54	48,04	99,99%	2.316,00	1,59099E-08
December / 2008	1.185.197,79	48,68	99,99%	2.547,00	0

Table 3 - Data Monitored for Adrianopolis Site in 2008

4.3.3. Data Monitored for Marambaia Site

The table bellow shows the monthly readings for the Marambaia Site.


		Variables Monitored for Marambaia Site Reference Year - 2008			
Reference Month / Year	Amount of LFG send to Flare (m3)	Methane average fraction (%)	Flare Efficiency (%)	Electric Energy Consumption (kWh)	Amount of LPG used (m3)
January / 2008	27.919,52	10,05	99,99%	400,80	6,20487E-07
February / 2008	10.030,90	15,20	99,99%	660,00	9,54595E-08
March / 2008	20.125,02	13,54	99,99%	739,20	1,11369E-07
April / 2008	97.228,19	21,80	99,99%	784,80	2,38649E-07
May / 2008	75.362,45	18,06	99,99%	852,00	4,77298E-08
June / 2008	28.426,94	14,57	99,99%	835,20	4,77298E-08
July / 2008	12.733,11	13,79	99,99%	832,80	1,90919E-07
August / 2008	77.915,97	13,83	99,99%	1.003,20	1,11369E-07
September / 2008	87.585,97	13,83	99,99%	1.000,80	1,59099E-08
October / 2008	293.104,84	17,69	99,99%	808,80	7,95496E-08
November / 2008	82.476,21	15,79	99,99%	420,00	7,95496E-08
December / 2008	47.289,03	12,68	99,99%	722,40	4,29568E-07

Table 4 - Data Monitored for Marambaia Site in 2008

4.4. Calculation of Emission Reduction for Adrianopolis Site

The table below shows the values for emission reduction in Adrianopolis site:


		Calculation ERs - Adrianopolis Site Reference Year - 2008			
Reference Month / Year	Total Gross ERs (tCO ₂ e)	Project Emission		Total Net ERs (tCO ₂ e)	ERs Accumulated (tCO ₂ e)
		Electrial Energy (tCO ₂ e)	LPG (tCO ₂ e)		
January / 2008	7518,52	0,85	9,91889E-10	7517,67	7.517,67
February / 2008	6797,06	0,76	4,95945E-10	6796,30	14.313,97
March / 2008	6840,28	0,87	3,96756E-10	6839,41	21.153,39
April / 2008	6075,90	0,54	1,09108E-09	6075,36	27.228,75
May / 2008	5924,54	0,68	9,91889E-11	5923,86	33.152,61
June / 2008	5303,23	0,44	1,38865E-09	5302,79	38.455,40
July / 2008	6308,52	0,43	1,19027E-09	6308,09	44.763,49
August / 2008	5968,29	0,53	1,98378E-10	5967,76	50.731,25
September / 2008	5330,04	0,38	7,93512E-10	5329,66	56.060,92
October / 2008	7482,29	0,64	3,96756E-10	7481,65	63.542,57
November / 2008	8178,47	0,66	9,91889E-11	8177,81	71.720,38
December / 2008	8246,14	0,72	0	8245,41	79.965,79

Table 5 - Values for emission reduction in Adrianopolis site in 2008

4.5. Calculation of Emission Reduction for Marambaia Site:

The table below shows the values for emission reduction in Marambaia site:

novagerar		Calculation ERs - Marambaia Site					
		Reference Year - 2008					
Reference Month / Year	Total Gross ERs - without EAF (tCO ₂ e)	EAF = 20% (tCO ₂ e)	Total Gross Ers (tCO ₂ e)	Project Emission (tCO ₂ e)		Total Net Ers (tCO ₂ e)	ERs Accumulated (tCO ₂ e)
				Electrial Energy (tCO ₂ e)	LPG (tCO ₂ e)		
January / 2008	43,97	8,79	35,17	0,130	3,86837E-09	35,04	35,04
February / 2008	28,04	5,61	22,43	0,232	5,95134E-10	22,20	57,24
March / 2008	40,51	8,10	32,41	0,243	6,94323E-10	32,16	89,41
April / 2008	317,08	63,42	253,66	0,208	1,48783E-09	253,45	342,86
May / 2008	212,42	42,48	169,94	0,228	2,97567E-10	169,71	512,57
June / 2008	70,35	14,07	56,28	0,249	2,97567E-10	56,03	568,60
July / 2008	32,83	6,57	26,26	0,214	1,19027E-09	26,05	594,65
August / 2008	178,77	35,75	143,02	0,252	6,94323E-10	142,76	737,41
September / 2008	193,68	38,74	154,95	0,244	9,91889E-11	154,70	892,12
October / 2008	423,13	84,63	338,50	0,208	4,95945E-10	338,29	1.230,41
November / 2008	237,39	47,48	189,91	0,120	4,95945E-10	189,79	1.420,21
December / 2008	180,88	36,18	144,71	0,206	2,6781E-09	144,50	1.564,71

Table 6 - Values for emission reduction in Marambaia site in 2008

4.6. Summary of the Emission Reduction of the Project

Volume required of the Emission Reduction for January to December, 2008 are calculated in 81,530 tCO₂e.


 Summary ERs of the Project Activity Reference Year: 2008				
Reference Month / Year	ERs Adrianopolis (tCO ₂ e)	ERs Marambaia (tCO ₂ e)	Total ERs (tCO ₂ e)	ERs Accumulated (tCO ₂ e)
January / 2008	7.517,67	35,04	7.552,72	7.552,72
February / 2008	6.796,30	22,20	6.818,50	14.371,22
March / 2008	6.839,41	32,16	6.871,58	21.242,79
April / 2008	6.075,36	253,45	6.328,82	27.571,61
May / 2008	5.923,86	169,71	6.093,57	33.665,18
June / 2008	5.302,79	56,03	5.358,82	39.024,00
July / 2008	6.308,09	26,05	6.334,14	45.358,14
August / 2008	5.967,76	142,76	6.110,53	51.468,67
September / 2008	5.329,66	154,70	5.484,37	56.953,03
October / 2008	7.481,65	338,29	7.819,95	64.772,98
November / 2008	8.177,81	189,79	8.367,60	73.140,59
December / 2008	8.245,41	144,50	8.389,91	81.530,50
Summary of Emission Reduction (tCO ₂ e) in reference year (2008)			81.530	

Table 7 – Summary of the emission reduction (tCO₂e) in 2008