MONITORING REPORT

AURÁ LANDFILL GAS PROJECT
AURÁ LANDFILL
CITY OF BELÉM, PARÁ, BRAZIL
(CDM REGISTRATION REFERENCE NUMBER 0888)

MONITORING PERIOD SEPTEMBER 1, 2009 – FEBRUARY 28, 2010

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1.0 INTRODUCTION

This Monitoring Report has been prepared by Conestoga-Rovers & Associates (CRA) for the landfill gas (LFG) collection and flaring system (System) constructed at the Aurá Landfill Site (Site) located in Belém, Pará, Brazil. This report quantifies the emission reductions achieved at the Aurá landfill for the monitoring period of September 1, 2009 to February 28, 2010.

The *Aurá Landfill Gas Project* (herein called Project) is being implemented by CRA according to the Project Design Document Version 4 of October 22, 2006. The project is registered at the UNFCCC's web site as of April 30, 2007 with the CDM Registration Reference Number 0888.

Additionally, there are no requests for deviation regarding these Site's submitted to the Executive Board during this crediting period.

1.1 PROJECT ACTIVITY

The project was developed at the Aurá Landfill, originally called the Aterro Sanitário do Aurá. The Site received non-hazardous solid municipal, industrial, commercial, institutional, and some agricultural wastes for approximately 15 years. Carbon dioxide (CO_2) and methane (CH_4) are generated by the anaerobic decomposition of the above-noted wastes placed at the Site. These compounds are then passively emitted to the atmosphere.

The project involved the construction of a LFG collection system consisting of horizontal trenches and vertical LFG extraction wells, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to collect the LFG.

The LFG collected from the Site is combusted in an enclosed LFG flare with full process controls and instrumentation installed and operating. The state-of-the-art flare is capable of providing sufficient temperature and retention time of the extracted LFG for complete destruction of hydrocarbons.

The purpose of the project activity is to collect LFG at the Aurá Landfill and combust the extracted LFG over a ten year-period, utilizing a high efficiency enclosed flare, thereby reducing greenhouse gas emissions (GHG) and generating Certified Emission Reductions (CERs).

1.2 PROJECT PARTICIPANTS

A list of the parties involved is provided below:

Name of Party Involved	*Private and/or public entities*
Brazil (Host Country)	Prefeitura Municipal de Belém, City of Belém, State of Pará (Public Entity)
Brazil (Host Country)	Conestoga-Rovers & Associados Engenharia S/A (Project Sponsor; Private Entity)
United Kingdom	Grey K Environmental (Europe) Ltd. (Private Entity)

1.3 PROJECT LOCATION

The Aurá Landfill is located 19 kilometers (km) from the centre of the City of Belém, State of Pará, and is 8 km from the centre of the City of Ananindeua. The entire Site covers an area of 120 hectares (ha) and the waste fill area of the Site is approximately 30 ha in size. The Site is located west of Curuperé Creek and east of the Parque Ambiental de Belém.

1.4 PROJECT DESCRIPTION

The technology used to gather the LFG is a grid of vertical gas extraction wells within the landfill, connected to a centralized blower system used to induce vacuum. Upon collection of the LFG, the methane component of the LFG is combusted in a state-of-the-art high-efficiency enclosed flare. The Global Warming Potential (GWP) of the LFG is reduced by the destruction of the methane portion of the LFG.

Vertical gas extraction wells are established in the waste material and are connected to the blower system through a network of underground piping installed on and around the perimeter of the landfill.

The extraction wells are connected to the subheader or directly to the header through smaller diameter laterals. As the blower is operated, a vacuum is applied through the

piping network, which in turn applied a vacuum to each well and extracts LFG out of the waste. The flow is controlled at each of the individual extraction wells through the use of a valve located at the top of the well piping. Each well is individually controlled to ensure that the collection system is effectively setup and balanced. The system is manually monitored and controlled at each wellhead and is equipped with a secure monitoring chamber and monitoring ports for gas composition, pressure, and temperature readings.

Non-perforated LFG collection piping will be utilized to convey the LFG from the extraction wells to the gas control plant. The LFG collection piping consists of a perimeter header, subheaders, and laterals. Header piping conveys the LFG collected from subheader collection piping to the gas control plant. Subheader piping conveys LFG from lateral piping to header piping, and lateral piping conveys LFG collected primarily at vertical gas extraction wells to the subheader piping.

The blower system is located in the gas control plant. An additional blower is available to allow for regular down time for maintenance and to provide backup in the event of a component failure. The blower system exerts vacuum through the piping system to the system of vertical wells. Extracted LFG is sent to the high-efficiency enclosed flare for destruction of the methane component of the extracted LFG. The stack height of the flare was selected to provide sufficient residence time for destruction of components in the gas at high temperature and in a controlled environment to destroy extracted methane. Flare temperature is controlled by a system of automatically and manually controlled air inlet dampers and thermocouples located in the stack.

2.0 CONTRIBUTION OF THE PROJECT ACTIVITY TO SUSTAINABLE DEVELOPMENT

The project will make a strong contribution to sustainable development in Brazil. Over and above reducing emissions of GHGs, there are other benefits to sustainable development such as:

- Contribution to recycling activities (help organize the wastepickers in a formal co-operative, improving work conditions and reducing health and safety hazards while increasing recycling rates)
- Contribution to human health and the environment (cleaner and healthier environment, improved air quality, reduced risk of landfill gas subsurface migration, minimized landfill fire, diminished potential for groundwater contamination)
- Contribution to the improvement of working conditions and employment creation (local employment during construction and operational phases)
- Contribution to income generation (generation of royalty revenue for local government entities throughout the ten-year crediting period of the project)
- Contribution to technological capacity building (local personnel training and information sharing)
- Contribution to regional integration and cooperation with other sectors (reference for other municipalities to implement similar projects at their landfill sites)

3.0 BASELINE METHODOLOGY

The approved baseline methodology applied to this project is the approved ACM0001 ver. 4 (dated July 2006) – Consolidated Baseline Methodology for Landfill Gas Project Activities.

All greenhouse gas (GHG) emission reductions generated by the implementation of the project activity are considered fully additional based on the lack of previous LFG management activities and the current environmental regulations in Brazil.

There are no existing or pending regulatory requirements requiring the Site to implement any form of LFG emission reductions program. There was no LFG recovery and combustion system in place at the Site prior to the project implementation. Therefore, the project baseline is the uncontrolled release of LFG to the atmosphere.

4.0 MONITORING METHODOLOGY

The approved monitoring methodology applied to this project activity is the ACM0001 version 4 – Consolidated Monitoring Methodology for Landfill Gas Project Activities. The LFG monitoring program is a relatively straightforward program designed to collect System operating data required to safely and effectively operate the System as required for the verification of CERs. This data is collected in real time, and provides a continuous record that is easy to monitor, review, and verify.

The monitoring methodology is based on the direct measurement of the quantity of LFG captured and destroyed by the LFG management system. The actual tonnage of methane emissions reduced by the project is calculated based on the flow rate of the LFG, methane concentration, and destruction/conversion efficiency of the combustion equipment. The monitoring plan provides for the continuous measurement of both LFG quantity and quality using a continuous flow meter and online LFG analyzer. The methane emissions reduced by the flare are determined based on the operating hours measured by a run-time meter. The destruction efficiency of the flare is directly correlated to the internal combustion temperature and the retention time of the unit. All data are aggregated approximately every second and are reported approximately every 2 minutes as per the monitoring methodology.

A summary of the data collected requirements for the project activity is provided in Table 1 and the monthly summaries showing the emission reductions achieved throughout the monitoring period are presented in Appendix A.

4.1 FLOW MEASUREMENT

LFG collected by the System and subsequently flared is measured via a flow measuring device suitable for measuring the velocity and volumetric flow of a gas. The flow measurements are taken within the piping itself, and the flow sensors are connected to a transmitter that is capable of collecting and sending continuous data to the recording device in this case a datalogger. The flow sensors are calibrated according to a specified temperature, pressure, and composition of the gas; thus the flow actually measured is corrected according to actual temperature, pressure, and composition, in order to provide the actual density of the gas measured. The equipment selected allows for dynamic compensation of these parameters, normalized to a standard temperature, pressure, and gas composition. For reporting purposes, the flows are required to be normalized to 0 degrees Celsius and 1 atm at standard gas composition of 50 percent methane and carbon dioxide each by volume.

Equipment calibration procedures are specified by the equipment manufacturer, and calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. The accuracy of a flow meter is dependent on the design of the equipment, and the specific type of sensor used. The equipment selected provides a minimum accuracy of +/- 2 percent by volume. The measured flow is aggregated approximately once per second.

All data that is collected is recorded for the permanent record. Both electronic and hard copies of the data are maintained for auditing purposes and for use in the calculation of CERs.

4.2 GAS QUALITY

The two parameters that are most pertinent to the verification of CERs, as well as the safe and efficient operation of the system, are the concentrations of methane and oxygen in the gas stream. These two parameters are measured via a common sample line that is run to the main collection system piping, and measured in real time by two separate sensors, one each for methane and oxygen.

Although compensation for temperature and pressure is not required for the methane and oxygen sensors, the sensors are designed to operate within specified temperature and pressure conditions. Equipment calibration procedures are specified by the equipment manufacturer, and calibration of the sensors is required on a regular basis to ensure the quality and validity of the data. Regular calibration of the equipment is especially important, as the accuracy of the methane and oxygen sensors is greatest within the expected calibration range of the gas stream to be measured. The equipment selected provides an accuracy of at least +/- 1 percent by volume. Gas compositions are aggregated approximately once per second.

4.3 OPERATIONAL MONITORING

Additional operational monitoring of the LFG collection wellfield is conducted in order to optimize the system and ensure it is operating both correctly and efficiently. Periodic adjustments to the extraction wells will be required to optimize the collection system effectiveness. The collection field adjustments are undertaken based upon a review of the extraction well performance history considered within the context of the overall field operation in order to maximize the collection of methane balanced against the

minimization of any oxygen in the system which could introduce unsafe operating conditions. Monitoring at each extraction well consists of using portable measuring devices to measure the following parameters:

- Valve position
- Individual well flow
- Individual well vacuum
- Composition of gas collected (i.e., methane, carbon dioxide, and oxygen)

5.0 EMISSION REDUCTIONS

5.1 OPERATIONAL DATA SOURCES

The operational data for the LFG collection and flaring system were obtained from the system datalogger, the Landtec Field Service Unit (FSU). Flow rate data, the gas composition data, and flare temperature data are all recorded and transmitted via the FSU. Daily volumetric flow rates of LFG are obtained from an average of multiple daily flow rates measured by the on-Site flow meter and recorded by the FSU. The LFG composition is analyzed by the Landtec Field Analytical Unit (FAU). Daily volumetric gas compositions of LFG are obtained from an average of multiple gas compositions measured by the on-Site gas analyzer and recorded by the FSU. Calculation of the operational run time for the flare is based on the number of minute-by-minute temperature readings.

Records of the calibration (via calibration certificates) are provided in Appendix B. Original copies of the calibration certificates will be made available to the third party verifier upon request during the Site visit component of the verification process. Calibration certificates provided in Appendix B include:

Item	*Serial/Identification Number*
Flow Meter	2008392
Calibration Gas	237187 and 542442

5.2 EMISSION REDUCTION CALCULATIONS

The amount of LFG collected and destroyed by combustion is monitored at a centralized location using a flow meter. Project emissions are comprised of the quantity of methane collected and not flared due to flare inefficiency and the quantity of energy required to operate the system based on the carbon dioxide emission intensity of the power source. This amount is subtracted from the measured quantity of collected methane. The flaring efficiency was measured on March 27, 2009. Based on this stack sampling event, the flaring efficiency of hydrocarbons for the enclosed flare is 99.99 percent.

A summary of the monthly emission reductions achieved at the Site is provided in Table 2.

The following formulae were used to estimate emission reductions for the project activity:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + EL_y * CEF_{electricity,y} + ET * CEF_{thermal,y}$$

Where:

- ER_y are the emission reductions, measured in tCO_2e
- $MD_{project,y}$ is the amount of methane actually destroyed/combusted during the year, measured in tCH_4
- $MD_{reg,y}$ is the amount of methane that would have been destroyed/combusted during time period t in the absence of the project activity, measured in tCH_4
- GWP_{CH4} is the approved Global Warming Potential value for methane, 21 tCO_2e/tCH_4
- EL_y is net quantity of electricity displaced during a given period t, measured in MWh
- $CEF_{electricity,y}$ is the CO_2 emissions intensity of the electricity displaced, measured in tCO_2e/MWh
- ET is the quantity of thermal energy displaced, measured in TeraJoules (TJ)
- $CEF_{thermal,y}$ is the CO_2 emissions intensity of the thermal energy displaced, measured in tCO_2e/TJ

It is noted that while the terms for electricity and thermal energy have been included to be consistent with the overall formulation stated in ACM0001 ver.4, energy displacement is not a component of the proposed project activity. As a result, the above equation reduces to the following form for the project activity:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4}$$

Considering that there is no regulatory or contractual requirement determining MDreg, an adjustment factor (AF) is used:

$$MD_{reg} = MD_{project} * AF$$

An "Adjustment Factor" needs to be considered to monitor the regulatory requirements relating to landfill gas projects. The situation regarding Aurá Landfill is described as follow:

- Based on the current LFG management practices at the Site and the current environmental regulations in Brazil, the GHG emission reductions generated by the implementation of the project activity are considered fully additional
- There are no existing or pending regulatory requirements requiring the landfill site to implement any form of LFG emission reductions program

Based on the project context, an "Adjustment Factor" of zero percent is used for the project.

$$MD_{reg,y} = MD_{project,y} \times AF$$
$$MD_{reg,y} = MD_{project,y} \times 0$$

The methane destroyed by the project activity during a given time period can be determined by the following: monitoring the quantity of methane actually flared and LFG used to generate electricity and to produce thermal energy, and is given by:

$$MD_{project} = MD_{flared} + MD_{electricity} + MD_{thermal}$$

For the proposed project activity, $MD_{electricity} = MD_{thermal} = 0$, as there is no energy displacement component of the project. As a result, the total actual quantity of methane captured and destroyed will be metered ex post once the project activity is operational, and:

$$MD_{project} = MD_{flared}$$

And,

$$MD_{flared,y} = LFG_{flare,y} * wCH_4,y * DCH_4 * FE$$

Where:

- $MD_{flared,y}$ is the quantity of methane destroyed by flaring in a given time period t, measured in tCH_4
- LFG_{flare} is the quantity of landfill gas flared during the time period t, measured in cubic meters (m^3)
- wCH_4 is the average methane fraction of the landfill gas as measured during the given time period t and expressed as a fraction of CH_4 volume per LFG volume (m^3 CH_4 / m^3 of LFG)

- FE is the flare efficiency (the fraction of the methane destroyed, in percent)
- DCH_4 is the methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at STP (0 degree Celsius and 1.013 bar), which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001 Ver. 4)

6.0 CER VOLUME CLAIMED

The crediting period for this project is from April 30, 2007 to April 29, 2017 (fixed). The CER volume claimed for the monitoring period extending from September 1, 2009 to February 28, 2010 is 87,604 tCO_2e. As recorded in the PDD, it was estimated that 327,151 tCO_2e and 344,905 tCO_2e would be claimed throughout the full 2009 and 2010 reporting years respectively. As this reporting period covers 4 months of the 2009 reporting year and 2 months of the 2010 reporting year the amount of estimated emission reductions as reported in the PDD for the monitoring period of September 1, 2009 through February 28, 2010 is approximately 166,534 tCO_2e. Of note, this value is an estimate and is not exact. Spreadsheets detailing the exact calculations/formulae will be made available at the third party verifiers request during the Site visit component of the verification process.

CALCULATION MEMO

Variable	*Unit*	*Quantity*
CO_2 Equivalent Reduced	tCO_2e	87,628
Total Electricity Consumed	MWh	105.4
CO_2 Emissions Produced	tCO_2	24
Total CO_2 Equivalent Reduced	tCO_2e	87,604

Notes:

1. CO_2 Equivalent Reduced includes a reduction for uncombusted methane due to flare destruction efficiency
2. An estimate of the grid emission factor for Brazil is calculated as 229 kg CO_2/MWh based on the calculation for the combined margin emission factor for the Brazilian interconnected grid, weighting the build margin and operating margin 75 percent and 25 percent respectively in accordance with the Tool to Calculate the Emission Factor for an Electricity System. The most recent data for the build margin and operating margin is for 2008 and is found on the Brazilian Governments Ministry of Science and Technology website (http://www.mct.gov.br/index.php/content/view/307492.html).

TABLE 1

SUMMARY OF DATA COLLECTION REQUIREMENTS
Aurá Landfill Gas Project
Aurá Landfill
Belém, Pará, Brazil

ID number	*Data Variable*	*Source of data*	*Data Unit*	*Measured (m), calculated ('c), estimated (e)*	*Recording Frequency*	*Proportion of data to be monitored*	*Method of data archival (electronic/paper)*	*Comment*
1. $LFG_{total,y}$	Total amount of landfill gas captured and flared	Online LFG flow meter (thermo mass)	Nm^3	m	Continuous	100%	Daily: electronic Monthly: paper	Measured by a flow meter which is calibrated periodically according to manufacturer's specifications by an officially accredited entity. The Thermo mass flow meter is capable to provide the volume in normalized cubic meters
2. FE	Flare/combustion efficiency determined by the operation hours (1) and the methane content in the exhaust gas (2).	Thermistors, Samples	%	m/c	(1) continuously; (2) Enclosed flares shall be monitored yearly, with the first measurement to be made at the time of installation	100%	Daily: electronic Monthly: paper	(1) The flare operation shall be continuously monitored by continuous measurement of operation time of flare using a run time meter connected to a flame detector or a flame continuous temperature controller, irrespective of whether the flare efficiency is monitored. (2) The enclosed flares shall be operated and maintained as per the specification prescribed by the manufacturer.
3. $w_{CH4,y}$	Methane fraction in the landfill gas	Online LFG analyzer	$m^3 CH_4 / m^3$ LFG	m	Continuous	100%	Daily: electronic Monthly: paper	Measured by continuous gas quality analyzer
4.	Total amount of electricity imported to meet project requirements	Electricity Meter	MWh	m	Continuous	100%	Daily: electronic Monthly: paper	Required to determine CO2 emissions from use of electricity
5.	CO_2 emission intensity of the electricity and/or other energy carriers in ID4	Calculated	tCO_2/MWh	c	Continuous	100%	Daily: electronic Monthly: paper	Required to determine CO2 emissions from use of electricity
6.	Regulatory requirements relating to landfill gas projects	Test	Test	n/a	Annualy	100%	Periodically	

TABLE 2

MONTHLY CERTIFIED EMISSION REDUCTIONS SUMMARY
SEPTEMBER 1, 2009 TO FEBRUARY 28, 2010
Aurá Landfill Gas Project
Belém, Pará, Brazil

	CO_2 Equivalent Reduced (tCO_2e/month)	*CO_2 Emissions Produced (tCO_2e)*	*Total CO_2 Equivalent Reduced (tCO_2e/month)*
Month - 2009			
September	11,928	4	11,924
October	13,761	3	13,758
November	15,869	4	15,865
December	15,588	4	15,584
Month - 2010			
January	15,646	4	15,642
February	14,836	5	14,831
Total Project Emissions/Reductions:	**87,628**	**24**	**87,604**

APPENDIX A

MONTHLY EMISSION REDUCTION SUMMARIES

TABLE A.1

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
SEPTEMBER 2009
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	71,678	2,987	40.3	1,440	99.99	435
2	71,480	2,978	39.6	1,440	99.99	426
3	71,609	3,017	39.3	1,424	99.99	424
4	66,065	2,753	38.9	1,440	99.99	387
5	63,394	2,641	38.6	1,440	99.99	368
6	59,701	2,488	39.8	1,440	99.99	357
7	59,434	2,476	40.1	1,440	99.99	359
8	64,946	2,717	39.2	1,434	99.99	383
9	62,061	2,589	40.0	1,438	99.99	373
10	63,845	2,660	40.2	1,440	99.99	386
11	68,030	2,835	39.5	1,440	99.99	404
12	63,330	2,701	39.8	1,407	99.99	380
13	58,823	2,458	39.8	1,436	99.99	352
14	69,213	2,888	35.7	1,438	99.99	372
15	51,025	3,243	29.6	944	99.99	227
16	35,966	2,893	41.8	746	99.99	226
17	47,903	3,292	39.3	873	99.99	283
18	77,065	3,211	39.8	1,440	99.99	462
19	76,597	3,192	39.5	1,440	99.99	455
20	74,524	3,105	39.7	1,440	99.99	445
21	69,619	3,049	40.4	1,370	99.99	423
22	72,397	3,021	40.1	1,438	99.99	437
23	70,812	3,030	39.9	1,402	99.99	426
24	70,968	2,961	39.8	1,438	99.99	425
25	72,115	3,005	39.5	1,440	99.99	429
26	76,404	3,192	39.8	1,436	99.99	458
27	79,019	3,306	39.5	1,434	99.99	469
28	77,346	3,227	39.3	1,438	99.99	458
29	72,828	3,035	40.7	1440	99.99	447
30	73,935	3,081	40.6	1440	99.99	452

Total CO_2 Equivalent Reduced (tCO_2e)	**11,928**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**15.168**
CO_2 Emissions Produced (tCO_2e)	**4**
Total CO_2 Equivalent Reduced (tCO_2e)	**11,924**

NOTES:

- **-** System down
- (1) Flow data recorded by the flow meter
- (2) Methane percentage recorded by the Landtec FAU Gas Analyzer
- (3) System up-time
- (4) Based on the flare methane destruction efficiency measurement
- (5) Calculated emission factor for the Brazilian interconnected grid

TABLE A.2

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
OCTOBER 2009
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	74,827	3,118	40.2	1,440	99.99	453
2	72,935	3,039	40.4	1,440	99.99	444
3	71,500	2,983	40.2	1,438	99.99	433
4	68,614	2,859	37.0	1,440	99.99	382
5	70,514	2,959	38.5	1,430	99.99	408
6	72,369	3,028	41.1	1,434	99.99	448
7	73,275	3,053	40.8	1,440	99.99	450
8	72,920	3,038	40.6	1,440	99.99	446
9	73,156	3,052	40.8	1,438	99.99	449
10	71,411	2,975	40.2	1,440	99.99	432
11	74,125	3,123	36.8	1,424	99.99	411
12	69,522	3,007	35.9	1,387	99.99	376
13	68,702	2,863	39.7	1,440	99.99	410
14	71,344	2,977	38.8	1,438	99.99	417
15	66,147	2,756	39.0	1,440	99.99	388
16	62,220	2,611	39.7	1,430	99.99	372
17	71,904	2,996	39.8	1,440	99.99	431
18	69,268	2,915	40.8	1,426	99.99	425
19	69,840	2,918	40.8	1,436	99.99	429
20	70,502	2,938	41.3	1,440	99.99	438
21	72,033	3,027	40.6	1,428	99.99	440
22	61,245	2,988	40.9	1,230	99.99	377
23	62,214	3,023	40.6	1,235	99.99	380
24	73,930	3,080	40.5	1,440	99.99	451
25	82,082	3,459	41.3	1,424	99.99	510
26	86,989	3,625	40.2	1,440	99.99	526
27	86,400	3,635	40.3	1,426	99.99	523
28	87,249	3,635	40.4	1,440	99.99	530
29	86,465	3,613	40.6	1,436	99.99	529
30	86,621	3,614	40.3	1,438	99.99	525
31	85,706	3,571	40.9	1,440	99.99	528

Total CO_2 Equivalent Reduced (tCO_2e)	**13,761**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**14.8**
CO_2 Emissions Produced (tCO_2e)	**3**
Total CO_2 Equivalent Reduced (tCO_2e)	**13,758**

NOTES:

- System down
(1) Flow data recorded by the flow meter
(2) Methane percentage recorded by the Landtec FAU Gas Analyzer
(3) System up-time
(4) Based on the flare methane destruction efficiency measurement
(5) Calculated emission factor for the Brazilian interconnected grid

TABLE A.3

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
NOVEMBER 2009
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	70,257	4,022	40.9	1,048	99.99	433
2	50,577	4,073	42.5	745	99.99	323
3	95,532	3,981	40.8	1,440	99.99	586
4	95,862	4,003	40.1	1,437	99.99	579
5	80,403	4,010	40.0	1,203	99.99	485
6	97,408	4,059	40.4	1,440	99.99	592
7	96,315	4,013	40.1	1,440	99.99	581
8	69,580	3,884	39.8	1,075	99.99	417
9	92,381	3,849	40.0	1,440	99.99	556
10	93,271	3,886	39.6	1,440	99.99	556
11	94,198	3,925	39.6	1,440	99.99	561
12	93,934	3,914	39.8	1,440	99.99	563
13	63,300	3,645	39.2	1,042	99.99	373
14	97,343	4,056	39.4	1,440	99.99	578
15	96,729	4,030	39.8	1,440	99.99	580
16	95,972	3,999	40.3	1,440	99.99	582
17	95,702	3,988	40.5	1,440	99.99	583
18	96,088	4,004	39.5	1,440	99.99	571
19	92,907	4,025	40.0	1,385	99.99	559
20	95,420	3,976	39.2	1,440	99.99	563
21	87,262	3,884	39.9	1,348	99.99	524
22	90,423	3,773	39.4	1,438	99.99	536
23	89,240	3,726	39.5	1,437	99.99	531
24	88,510	3,688	40.1	1,440	99.99	535
25	87,384	3,713	40.1	1,412	99.99	527
26	85,207	3,555	40.1	1,438	99.99	514
27	85,684	3,570	40.1	1,440	99.99	517
28	84,869	3,536	39.9	1,440	99.99	510
29	88,255	3,677	39.3	1,440	99.99	522
30	88,353	3,681	40.0	1,440	99.99	532

Total CO_2 Equivalent Reduced (tCO_2e)	**15,869**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**16.9**
CO_2 Emissions Produced (tCO_2e)	**4**
Total CO_2 Equivalent Reduced (tCO_2e)	**15,865**

NOTES:

- System down
(1) Flow data recorded by the flow meter
(2) Methane percentage recorded by the Landtec FAU Gas Analyzer
(3) System up-time
(4) Based on the flare methane destruction efficiency measurement
(5) Calculated emission factor for the Brazilian interconnected grid

TABLE A.4

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
DECEMBER 2009
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	81,705	3404	40.6	1,440	99.99	499
2	92,111	3838	40.3	1,440	99.99	558
3	93,434	3893	40.8	1,440	99.99	573
4	95,226	3968	40.6	1,440	99.99	582
5	74,098	4071	41.4	1,092	99.99	462
6	84,752	3536	40.7	1,438	99.99	519
7	78,310	3263	42.2	1,440	99.99	497
8	79,630	3614	40.7	1,322	99.99	487
9	87,098	3634	38.6	1,438	99.99	506
10	87,575	3649	37.4	1,440	99.99	493
11	83,827	3626	38.7	1,387	99.99	489
12	86,517	3605	38.0	1,440	99.99	495
13	88,022	3668	36.2	1,440	99.99	480
14	86,584	3608	37.3	1,440	99.99	486
15	83,979	3499	39.1	1,440	99.99	495
16	83,762	3507	40.0	1,433	99.99	505
17	83,987	3566	39.7	1,413	99.99	501
18	84,411	3527	38.3	1,436	99.99	486
19	83,912	3504	38.7	1,437	99.99	488
20	84,582	3524	39.2	1,440	99.99	499
21	81,751	3406	39.4	1,440	99.99	485
22	80,823	3368	40.0	1,440	99.99	487
23	84,666	3528	39.8	1,440	99.99	507
24	83,860	3494	39.7	1,440	99.99	502
25	82,894	3454	39.9	1,440	99.99	497
26	79,529	3480	41.1	1,371	99.99	492
27	84,110	3505	40.6	1,440	99.99	514
28	77,409	3248	41.3	1,430	99.99	481
29	83,010	3464	41.0	1,438	99.99	512
30	82,673	3496	40.1	1,419	99.99	498
31	84,920	3571	40.2	1,427	99.99	513

Total CO_2 Equivalent Reduced (tCO_2e)	**15,588**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**19.0**
CO_2 Emissions Produced (tCO_2e)	**4**
Total CO_2 Equivalent Reduced (tCO_2e)	**15,584**

NOTES:

- **-** System down
- (1) Flow data recorded by the flow meter
- (2) Methane percentage recorded by the Landtec FAU Gas Analyzer
- (3) System up-time
- (4) Based on the flare methane destruction efficiency measurement
- (5) Calculated emission factor for the Brazilian interconnected grid

TABLE A.5

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
JANUARY 2010
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	88,272	3678	34.4	1,440	99.99	457
2	85,618	3567	26.4	1,440	99.99	340
3	46,219	3668	29.5	756	99.99	205
4	86,615	3609	37.9	1,440	99.99	494
5	86,917	3642	37.9	1,432	99.99	496
6	88,588	3733	37.2	1,424	99.99	496
7	94,257	3930	38.9	1,439	99.99	552
8	94,726	3947	37.8	1,440	99.99	539
9	90,272	3852	38.8	1,406	99.99	527
10	96,280	4012	35.7	1,440	99.99	517
11	96,137	4017	37.4	1,436	99.99	542
12	96,933	4044	38.7	1,438	99.99	565
13	98,230	4093	38.8	1,440	99.99	573
14	100,310	4180	37.3	1,440	99.99	562
15	88,429	3927	37.6	1,351	99.99	500
16	92,336	3847	37.7	1,440	99.99	523
17	76,375	3816	39.4	1,201	99.99	453
18	94,806	3950	38.5	1,440	99.99	550
19	90,630	3792	37.8	1,434	99.99	516
20	86,534	3869	39.5	1,342	99.99	514
21	90,297	3807	39.3	1,423	99.99	535
22	58,082	3641	41.3	957	99.99	361
23	90,471	3780	40.4	1,436	99.99	550
24	89,268	3720	39.6	1,440	99.99	531
25	85,094	3546	40.0	1,440	99.99	512
26	86,347	3598	41.0	1,440	99.99	533
27	85,564	3565	42.5	1,440	99.99	547
28	86,589	3608	42.5	1,440	99.99	553
29	85,921	3585	42.8	1,438	99.99	553
30	89,543	3731	42.0	1,440	99.99	566
31	87,235	3892	36.8	1,345	99.99	484

Total CO_2 Equivalent Reduced (tCO_2e)	**15,646**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**18.6**
CO_2 Emissions Produced (tCO_2e)	**4**
Total CO_2 Equivalent Reduced (tCO_2e)	**15,642**

NOTES:

- **-** System down
- (1) Flow data recorded by the flow meter
- (2) Methane percentage recorded by the Landtec FAU Gas Analyzer
- (3) System up-time
- (4) Based on the flare methane destruction efficiency measurement
- (5) Calculated emission factor for the Brazilian interconnected grid

TABLE A.6

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
FEBRUARY 2010
Aurá Landfill Gas Project
Belém, Pará, Brazil

Day	*Volume (Nm^3)*	*Flow [1] (Nm^3/h)*	*Methane [2] (%)*	*Net Flare Operational Period [3] (min)*	*Flare Destruction Efficiency [4] (%)*	*CO_2 Equivalent Reduced (tCO_2e)*
1	89,021	3709	39.2	1,440	99.99	526
2	85,878	3578	41.8	1,440	99.99	540
3	89,431	3726	40.1	1,440	99.99	540
4	91,012	3792	38.8	1,440	99.99	532
5	86,353	3598	40.3	1,440	99.99	524
6	80,146	3346	43.5	1,437	99.99	525
7	82,023	3432	43.5	1,434	99.99	537
8	71,426	3536	42.7	1,212	99.99	459
9	34,629	3330	43.7	624	99.99	228
10	80,145	3377	44.1	1,424	99.99	532
11	81,962	3493	41.5	1,408	99.99	512
12	80,676	3361	43.7	1,440	99.99	531
13	83,227	3473	44.0	1,438	99.99	552
14	88,373	3682	44.0	1,440	99.99	585
15	89,158	3715	43.2	1,440	99.99	579
16	87,523	3677	42.4	1,428	99.99	558
17	90,730	3780	40.1	1,440	99.99	547
18	88,914	3705	41.3	1,440	99.99	552
19	90,262	3761	40.7	1,440	99.99	553
20	82,695	3742	40.8	1,326	99.99	508
21	91,919	3841	41.0	1,436	99.99	568
22	94,025	3984	40.7	1,416	99.99	577
23	93,747	3912	39.3	1,438	99.99	555
24	83,963	3543	37.4	1,422	99.99	473
25	94,980	3985	39.1	1,430	99.99	559
26	95,834	4015	37.4	1,432	99.99	539
27	95,973	3999	40.3	1,440	99.99	582
28	93,354	4074	40.1	1,375	99.99	563

Total CO_2 Equivalent Reduced (tCO_2e)	**14,836**
CO_2 Emission Intensity [5] (tCO2e/MWh)	**0.229**
Quantity of Electricity Imported (MWh)	**20.9**
CO_2 Emissions Produced (tCO_2e)	**5**
Total CO_2 Equivalent Reduced (tCO_2e)	**14,831**

NOTES:

- System down
(1) Flow data recorded by the flow meter
(2) Methane percentage recorded by the Landtec FAU Gas Analyzer
(3) System up-time
(4) Based on the flare methane destruction efficiency measurement
(5) Calculated emission factor for the Brazilian interconnected grid

APPENDIX B

CALIBRATION CERTIFICATES

SERIAL NUMBER 2008392 **10-15-2008**

COMPONENT VALUES DETERMINED AT CALIBRATION

Integral Transducer

PCB 100385	**PCB 100389**
R5 825	R10 1870
R7 700	
R8 90.9	
R9 909	
R15 5760	

FLOW SENSOR - 50 OHMS NI @ 75 deg F
TEMP SENSOR - 100 OHMS NI @ 75 deg F

CALIBRATION POTENTIOMETERS

TA 403 TC 593

OPERATING RANGE

	minimum	**maximum**
FLOW	0	6800 SCMH LFG
TEMPERATURE	40	200 F
PRESSURE	0	15 PSIG

COMMENTS --

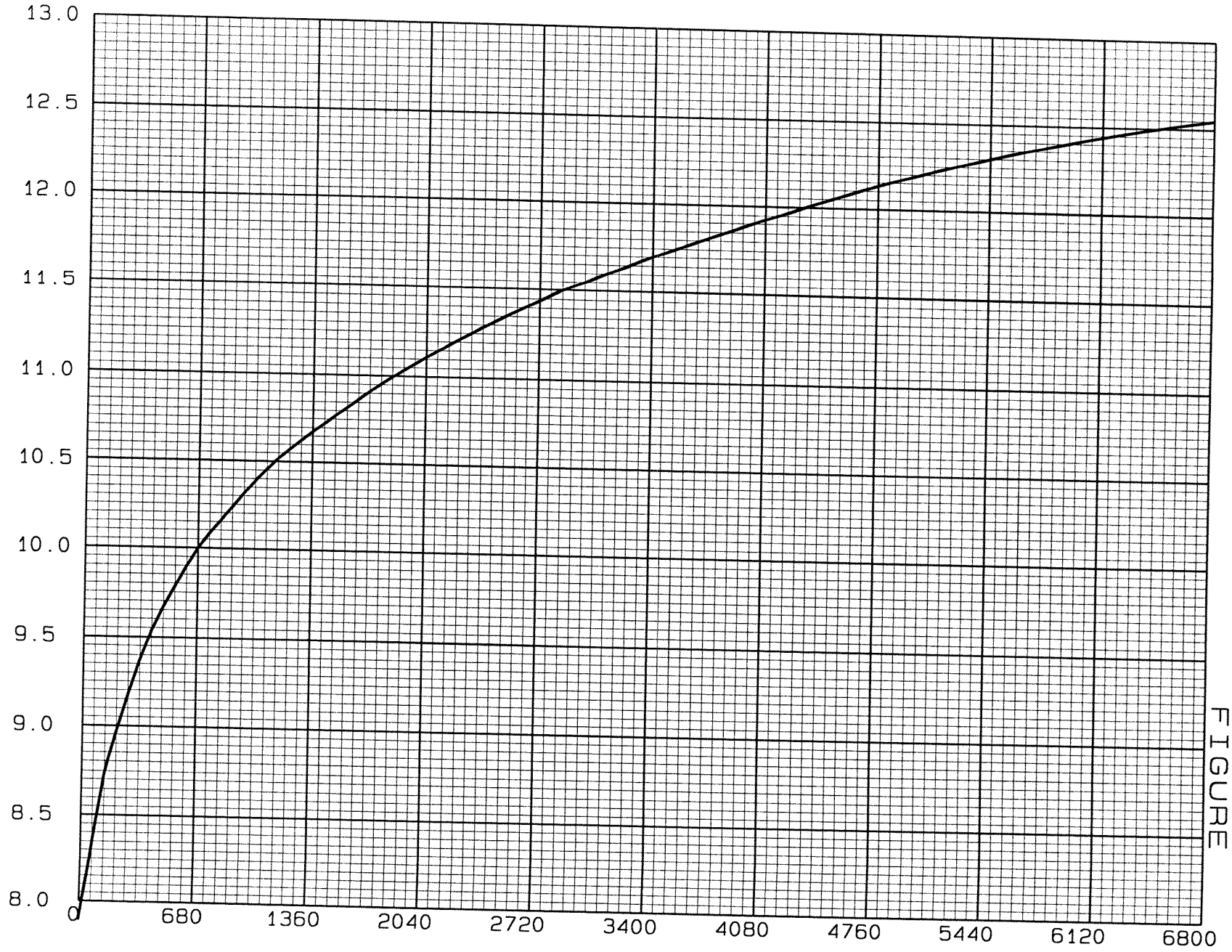
METER CALIBRATED FOR 11.26" ID(286mm)

METER OUTPUT SIGNAL CALIBRATION

mA	**SCMH LFG**	**EXC Volts**
4	0	7.890
4.32	136	8.740
4.64	272	9.177
4.96	408	9.537
5.28	544	9.785
5.6	680	10.000
7.2	1360	10.675
8.8	2040	11.110
10.4	2720	11.440
12	3400	11.700
13.6	4080	11.925
15.2	4760	12.130
16.8	5440	12.300
18.4	6120	12.440
20	6800	12.550

9500 EEPROM Setup Data

Maximum Calibrated Flow	6800
Flow FS at 20ma	6800.0
Flow Full Scale Displayed	6800.0
Totalizer Counts per/hour	6800
Totalizer Decimal Point	0
Zero Offset	0
Display Cutoff	5% FS
Filter Time Constant	2 Sec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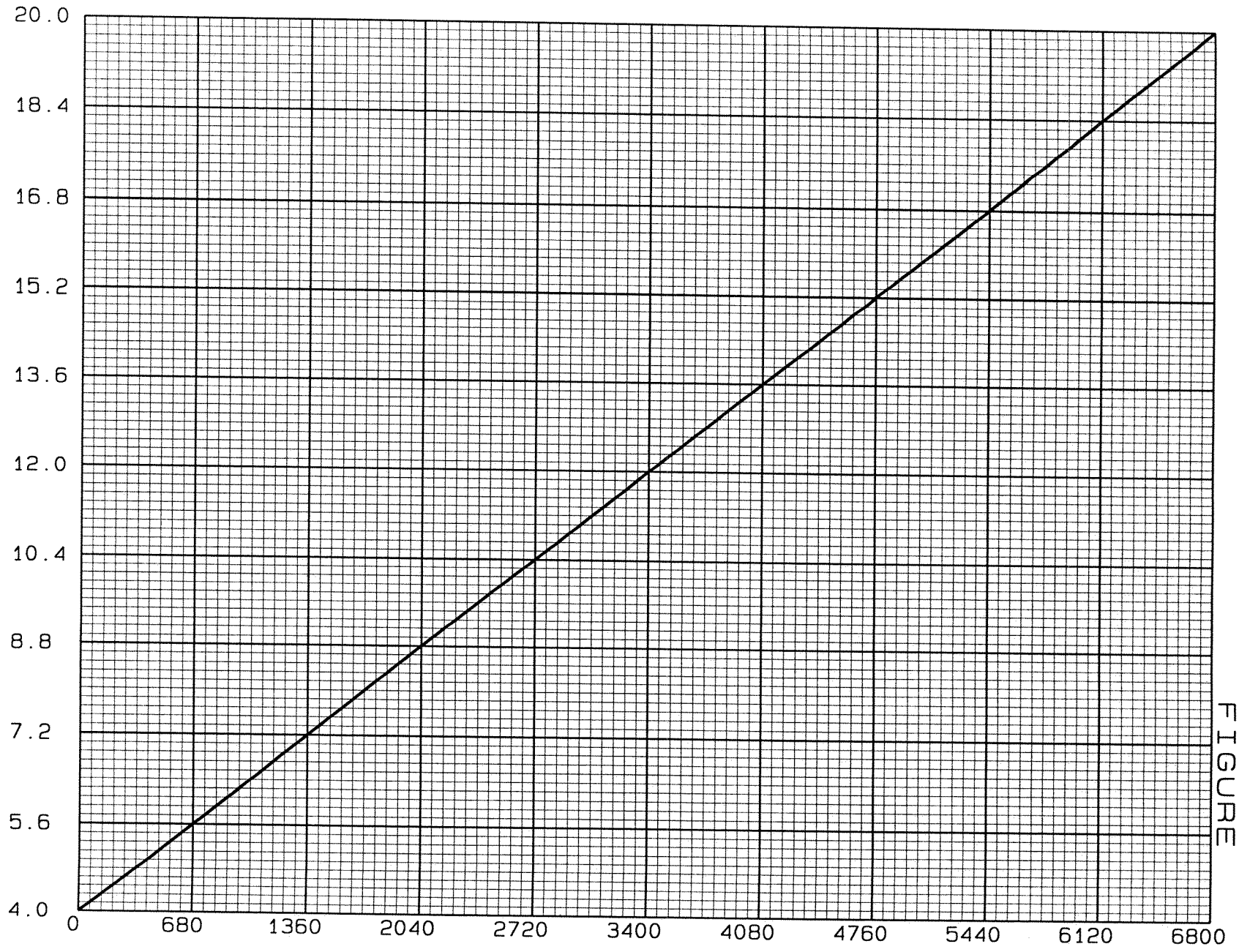
12.5
12.0
11.5
11.0
10.5
10.0
9.5
9.0
8.5
8.0
0
680
1360
2040
2720
3400
4080
4760
5440
6120
6800
SCMH LFG 11.26" ID
S/N 2008392.0
10-15-2008

PAGE

FIGURE



FIGURE

SCMH LFG 11.26" ID

S/N 2008392.0
10-15-2008

White Martins Gases Industriais Ltda. - Laboratório de Controle da Qualidade Gases Especiais
Av. dos Autonomistas, 4332 - Osasco - São Paulo - CEP 06090-015
Telefone: (11) 3685-7729 - Fax: (11) 3685-7852 - E-mail: antonio_giorgio@praxair.com

SISTEMA DA QUALIDADE CERTIFICADO CONFORME A NORMA ISO 9001 GASES ESPECIAIS OSASCO

CERTIFICADO DE GARANTIA DA QUALIDADE

Número da Ordem: 41096434 Certificado Nº : 40504471 Pedido Nº : 69868844 Página 1 de 1

Cilindro Nº : 237187 Conexão SAWM Nº: 02 ABNT: 218-2

Cliente : 43771814 CRA ENGENHARIA

Endereço : ESTRADA DO AURA 0 DENTRO LIXAO

ANANINDEUA PA BRA

Composição da Mistura

Nome do Produto : Mistura Padrão Primario Cil T

Componentes	Método de Verificação	Requisitado		Reportado		Incerteza de Medição
Metano	P	50	% Mol / Mol	49,96	% Mol / Mol	+/- 0,34 %
Dioxido Carbono	P	35	% Mol / Mol	34,99	% Mol / Mol	+/- 0,20 %
Nitrogenio		BALANÇO				

Tipo do Cilindro : T Padrão : Primario

Pressão : 118,00 kgf/cm2 ou 11.571,85 kPa

Volume : 7,700 m3 @ 21,1 °C e 101,32 kPa ou 1atm

Método de Confecção : Método Gravimétrico Data de Confecção : 02/09/09 Data de Validade : 02/09/14

Rastreável a massas padrões conforme certificado de calibração da RBC-INMETRO nº M-25944/08.

A incerteza expandida relatada é baseada em uma incerteza padrão combinada, multiplicada por um fator de abrangência K=2, para um nível de confiança de 95%.

Data : 04/09/09 Analista : 44863626 Responsável Silva, Cristiane de Oliveira

Eliane Miyuki Sakuda Taira
Gerente de Controle de Qualidade de Gases Especiais

Observações

Métodos de Verificação

- .	H - Quimiluminescência	P - Gravimétrico
A - Cromatografia Gasosa (ECD)	I - Emissão Optica	Q - FID + Metanador
B - Cromatografia Gasosa (TCD)	J - Condutividade Térmica	R - Fotoionização (PID)
C - Eletrolítico	K - Paramagnetismo	S - Obtido por diferença de 100%
D - Cromatografia Gasosa (FID)	L - Fluorescência de Ultravioleta	T - Especificação do Fornecedor
E - Ionização de Chama	M - Ionização de Hélio	
F - Infra-Vermelho	N - Célula de Cristal Higroscópico	
G - Célula Eletroquímica	O - Tubo Drager	

Os resultados apresentados neste documento têm significação restrita e se aplicam somente ao(s) cilindro(s) referido(s).
A reprodução do documento só poderá ser feita integralmente, sem nenhuma alteração.
Estabilidade garantida, desde que o cilindro seja armazenado em local seco, ventilado, ao abrigo de intempéries, e entre as temperaturas de 10 a 35° C.

Equivalência de Unidades	
%	% mol / mol
ppm	micromol / mol
ppb	nanomol / mol

Telefone de Emergência:
0800 709 9000

White Martins Gases Industriais Ltda. - Laboratório de Controle da Qualidade Gases Especiais
Av. dos Autonomistas, 4332 - Osasco - São Paulo - CEP 06090-015
Telefone: (11) 3685-7729 - Fax: (11) 3685-7852 - E-mail: antonio_giorgio@praxair.com

SISTEMA DA QUALIDADE CERTIFICADO CONFORME A NORMA ISO 9001 GASES ESPECIAIS OSASCO

CERTIFICADO DE GARANTIA DA QUALIDADE

Número da Ordem: 41127923 Certificado Nº : 40525581 Pedido Nº : 70789556 Página 1 de 1

Cilindro Nº : 542442 Conexão SAWM Nº: 01 ABNT: 245-1

Cliente : 43771814 CRA ENGENHARIA

Endereço : ESTRADA DO AURA 0 DENTRO LIXAO

ANANINDEUA PA BRA

Composição da Mistura

Nome do Produto : Mistura Padrão Primario Cil T

Componentes	Método de Verificação	Requisitado		Reportado		Incerteza de Medição
Oxigenio	P	4	% Mol / Mol	4,003	% Mol / Mol	+/- 0,23 %
Nitrogenio		BALANÇO				

Tipo de Cilindro : T Padrão : Primario

Pressão : 185,00 kgf/cm2 ou 18.142,30 kPa

Volume : 8,700 m3 @ 21,1 ºC e 101,32 kPa ou 1atm

Método de Confecção : Método Gravimétrico Data de Confecção : 22/10/09 Data de Validade : 22/10/14

Rastreável a massas padrões conforme certificado de calibração da RBC-INMETRO nº M-25944/08.

A incerteza expandida relatada é baseada em uma incerteza padrão combinada, multiplicada por um fator de abrangência K=2, para um nível de confiança de 95%.

Data : 29/10/09 Analista : 44863626 Responsável Silva, Cristiane de Oliveira

Eliane Miyuki Sakuda Taira
Gerente de Controle de Qualidade de Gases Especiais

Observações

Métodos de Verificação

-	H - Quimiluminescência	P - Gravimétrico
A - Cromatografia Gasosa (ECD)	I - Emissão Optica	Q - FID + Metanador
B - Cromatografia Gasosa (TCD)	J - Condutividade Térmica	R - Fotoionização (PID)
C - Eletrolítico	K - Paramagnetismo	S - Obtido por diferença de 100%
D - Cromatografia Gasosa (FID)	L - Fluorescência de Ultravioleta	T - Especificação do Fornecedor
E - Ionização de Chama	M - Ionização de Hélio	
F - Infra-Vermelho	N - Célula de Cristal Higroscópico	
G - Célula Eletroquímica	O - Tubo Drager	

Os resultados apresentados neste documento têm significação restrita e se aplicam somente ao(s) cilindro(s) referido(s).
A reprodução do documento só poderá ser feita integralmente, sem nenhuma alteração.
Estabilidade garantida, desde que o cilindro seja armazenado em local seco, ventilado, ao abrigo de intempéries, e entre as temperaturas de 10 a 35° C.

Equivalência de Unidades	
%	% mol / mol
ppm	micromol / mol
ppb	nanomol / mol

Telefone de Emergência:
0800 709 9000