MONITORING REPORT

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

MONITORING PERIOD OCTOBER 1, 2008 – JANUARY 31, 2009

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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, Brasil. This report quantifies the emission reductions achieved at the Aurá landfill for the monitoring period of October 1, 2008 to January 31, 2009.

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.

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*
Brasil (Host Country)	Prefeitura Municipal de Belém, City of Belém, State of Pará (Public Entity)
Brasil (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 Brasil. 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); and
- 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 Brasil.

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 measure 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.

A summary of the data collected requirements for the project activity is provided in Table 1.

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; and
- 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.

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 August 26, 2008. 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 formula was used to estimate emission reductions for the project activity:

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

where:

- ER_y are the emission reductions, measured in tCO_2e;
- $MD_{project,y}$ is the amount of methane actually destroyed/combusted during time period T, 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; and

- GWP_{CH4} is the approved Global Warming Potential value for methane, 21 tCO_2e/tCH_4.

The total amount of methane destroyed by the flare in a given period is calculated as:

$$MD_{flared,y} = LFG_{flare,y} \times w_{CH4,y} \times D_{CH4} \times FE$$

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 LFG flared during a given time period t, measure in cubic meters (m^3);
- w_{CH4} is the average methane fraction of the LFG as measured during the given time period t and expressed as a fraction of CH_4 volume per LFG volume (m^3CH_4/m^3 LFG);
- D_{CH4} is the methane density, expressed in tonnes of methane per cubic meter of methane (tCH_4/m^3CH_4), and measured at standard pressure (1 atm) and temperature (0°C) conditions, which is 0.0007168 tCH_4/m^3CH_4 (as per consolidated methodology ACM0001 version 4); and
- FE is the flare efficiency (the fraction of the methane destroyed, as determined by quarterly flare stack monitoring).

6.0 CER VOLUME CLAIMED

The CER volume claimed for the monitoring period extending from October 1, 2008 to January 31, 2009 is 51,529 tCO_2e.

CALCULATION MEMO

Variable	*Unit*	*Quantity*
CO_2 Equivalent Reduced	tCO_2e	51,548
Total Electricity Consumed	MW	37.4
CO_2 Emissions Produced	tCO_2	19
Total CO_2 Equivalent Reduced	tCO_2e	51,529

Note:

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 Brasil is calculated as 489 kg CO_2/MWh based on the default emission factor for the Brazilian North-Northeast interconnected grid.

TABLE 1

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

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	Online LFG flow meter	m^3	m	Continuous	100%	Daily: electronic Monthly: paper	Measured by a flow meter
2. $LFG_{flare,y}$	Total amount of landfill gas flared	Online LFG flow meter	m^3	m	Continuous	100%	Daily: electronic Monthly: paper	Measured by a flow meter or calculated using flare efficiency from
5. 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) quarterly, monthly if unstable	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. (3) The enclosed flares shall be operated and maintained as per the specification prescribed by the manufacturer.
6. $w_{CH4,y}$	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
7. T	Temperature of the landfill gas	Temperature Probe	°C	m	Continuous	100%	Daily: electronic Monthly: paper	Measured to determine the density of methane D_{CH4}. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
8. P	Pressure of the landfill gas	Pressure Gauge	Pa	m	Continuous	100%	Daily: electronic Monthly: paper	Measured to determine the density of methane D_{CH4}. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
10. EL_{IMP}	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
11.	CO_2 emission intensity of the electricity and/or other energy carriers	Calculated	tCO_2/MWh	c	As specified in ACM0002	100%	Daily: electronic Monthly: paper	In case a specific source is displaced or used for imports, the emission factor is estimated for that specific source.
13.	Regulatory requirements relating to landfill gas projects	Test	Test	n/a	At the renewal of crediting period	100%	Periodically	The information, though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{reg,y}$ at renewal of the credit period.

TABLE 2

MONTHLY CERTIFIED EMISSION REDUCTIONS SUMMARY
OCTOBER 1, 2008 TO JANUARY 31, 2009
Aurá Landfill Gas Project
Belém, Pará, Brasil

	CO_2 *Equivalent* Reduced (tCO_2 *e/day)*	CO_2 *Emissions* Produced (tCO_2 *e)*	Total CO_2 *Equivalent* Reduced (tCO_2 *e/day)*
Month - 2008			
October	14,228	5	14,223
November	13,450	6	13,444
December	12,214	7	12,207
Month - 2009			
January	11,656	1	11,655
Total Project Emissions/Reductions:	**51,548**	**19**	**51,529**

APPENDIX A

MONTHLY EMISSION REDUCTION SUMMARIES

TABLE A.1

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
OCTOBER 2008
Aurá Landfill Gas Project
Belém, Pará, Brasil

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	60,488	3,107	43.3	1,168	99.99	394
2	71,260	3,107	41.6	1,376	99.99	446
3	77,665	3,236	37.9	1,440	99.99	443
4	62,155	3,185	35.4	1,171	99.99	331
5	82,010	3,417	13.0	1,440	99.99	161
6	50,876	3,293	29.5	927	99.99	226
7	73,035	3,062	44.9	1,431	99.99	494
8	73,201	3,050	46.7	1,440	99.99	515
9	73,854	3,077	46.0	1,440	99.99	511
10	74,988	3,124	43.8	1,440	99.99	494
11	76,326	3,180	41.8	1,440	99.99	481
12	75,918	3,242	41.7	1,405	99.99	477
13	67,654	3,245	42.3	1,251	99.99	430
14	80,503	3,354	41.1	1,440	99.99	498
15	80,797	3,653	39.1	1,327	99.99	475
16	86,973	3,667	38.1	1,423	99.99	498
17	85,554	3,635	40.1	1,412	99.99	517
18	81,482	3,787	38.3	1,291	99.99	470
19	88,631	3,788	37.6	1,404	99.99	501
20	87,481	3,653	39.8	1,437	99.99	524
21	90,872	3,786	39.5	1,440	99.99	540
22	89,842	3,743	38.4	1,440	99.99	520
23	80,063	3,566	39.5	1,347	99.99	476
24	84,738	3,603	39.2	1,411	99.99	500
25	83,587	3,517	40.0	1,426	99.99	504
26	83,570	3,521	40.0	1,424	99.99	503
27	84,196	3,508	39.9	1,440	99.99	506
28	82,817	3,492	40.0	1,423	99.99	498
29	78,128	3,530	40.5	1,328	99.99	477
30	78,561	3,637	40.8	1,296	99.99	482
31	56,856	3,680	39.3	927	99.99	336

Total CO_2 Equivalent Reduced (tCO_2e)	**14,228**
CO_2 Emission Intensity [(5)] (tCO2e/MWh)	**0.489**
Quantity of Electricity Imported (MWh)	**9.4**
CO_2 Emissions Produced (tCO_2e)	**5**
Total CO_2 Equivalent Reduced (tCO_2e)	**14,223**

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) Default emission factor for the Brazilian North-Northeast interconnected grid

TABLE A.2

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
NOVEMBER 2008
Aurá Landfill Gas Project
Belém, Pará, Brasil

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	42,286	3,584	42.8	708	99.99	272
2	61,586	3,543	39.4	1,043	99.99	365
3	21,911	3,388	40.3	388	99.99	133
4	80,315	3,346	38.5	1,440	99.99	465
5	51,564	3,281	43.0	943	99.99	334
6	42,466	3,213	44.2	793	99.99	282
7	23,590	3,174	43.5	446	99.99	154
8	75,802	3,158	45.8	1,440	99.99	523
9	75,754	3,156	45.8	1,440	99.99	522
10	71,728	3,207	46.0	1,342	99.99	496
11	80,422	3,420	42.5	1,411	99.99	515
12	81,314	3,569	40.2	1,367	99.99	492
13	87,699	3,654	39.5	1,440	99.99	521
14	89,860	3,744	39.0	1,440	99.99	528
15	84,399	3,710	40.5	1,365	99.99	514
16	88,644	3,694	39.3	1,440	99.99	525
17	88,974	3,738	39.4	1,428	99.99	528
18	91,593	3,816	38.5	1,440	99.99	530
19	84,120	3,806	40.2	1,326	99.99	509
20	93,651	3,902	37.7	1,440	99.99	531
21	94,459	4,063	36.1	1,395	99.99	513
22	89,839	3,743	38.5	1,440	99.99	521
23	63,885	3,137	45.0	1,222	99.99	432
24	75,796	3,158	41.5	1,440	99.99	473
25	77,664	3,236	39.7	1,440	99.99	464
26	75,690	3,154	40.0	1,440	99.99	456
27	73,877	3,078	40.0	1,440	99.99	444
28	62,394	3,261	44.0	1,148	99.99	413
29	80,138	3,339	42.8	1,440	99.99	517
30	79,956	3,331	39.7	1,440	99.99	478

Total CO_2 Equivalent Reduced (tCO_2e)	**13,450**
CO_2 Emission Intensity (5) (tCO2e/MWh)	**0.489**
Quantity of Electricity Imported (MWh)	**11.8**
CO_2 Emissions Produced (tCO_2e)	**6**
Total CO_2 Equivalent Reduced (tCO_2e)	**13,444**

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) Default emission factor for the Brazilian North-Northeast interconnected grid

TABLE A.3

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
DECEMBER 2008
Aurá Landfill Gas Project
Belém, Pará, Brasil

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	65,391	3,466	34.2	1,132	99.99	336
2	63,130	3,462	30.6	1,094	99.99	290
3	50,432	3,431	44.5	882	99.99	338
4	80,985	3,374	33.8	1,440	99.99	412
5	81,593	3,400	16.9	1,440	99.99	208
6	82,192	3,425	20.6	1,440	99.99	255
7	81,971	3,415	21.7	1,440	99.99	268
8	82,512	3,438	21.5	1,440	99.99	267
9	69,403	3,556	27.2	1,171	99.99	284
10	61,669	3,429	21.1	1,079	99.99	196
11	86,051	3,608	41.4	1,431	99.99	536
12	84,280	3,574	39.7	1,415	99.99	504
13	87,183	3,633	39.2	1,440	99.99	514
14	86,877	3,620	5.0	1,440	99.99	66
15	84,928	3,611	27.3	1,411	99.99	349
16	86,655	3,641	39.2	1,428	99.99	511
17	83,269	3,636	40.7	1,374	99.99	510
18	84,864	3,611	39.4	1,410	99.99	504
19	78,775	3,493	39.2	1,353	99.99	464
20	81,802	3,425	40.7	1,433	99.99	501
21	48,521	3,474	41.0	838	99.99	299
22	82,580	3,441	39.9	1,440	99.99	496
23	66,571	3,507	39.2	1,139	99.99	393
24	83,269	3,470	39.8	1,440	99.99	499
25	82,222	3,426	39.9	1,440	99.99	494
26	81,035	3,376	40.4	1,440	99.99	493
27	81,941	3,414	39.5	1,440	99.99	487
28	65,332	3,487	39.3	1,124	99.99	386
29	61,518	3,644	40.3	1,013	99.99	374
30	83,734	3,489	39.2	1,440	99.99	494
31	82,914	3,455	38.9	1440	99.99	486

Total CO_2 Equivalent Reduced (tCO_2e)	**12,214**
CO_2 Emission Intensity [(5)] (tCO2e/MWh)	**0.489**
Quantity of Electricity Imported (MWh)	**14.1**
CO_2 Emissions Produced (tCO_2e)	**7**
Total CO_2 Equivalent Reduced (tCO_2e)	**12,207**

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) Default emission factor for the Brazilian North-Northeast interconnected grid

TABLE A.4

CERTIFIED EMISSION REDUCTIONS (CER) CALCULATIONS
JANUARY 2009
Aurá Landfill Gas Project
Belém, Pará, Brasil

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	83,008	3466	37.8	1,437	99.99	473
2	69,287	3565	37.7	1,166	99.99	393
3	87,617	3651	35.9	1,440	99.99	474
4	79,594	3468	36.2	1,377	99.99	433
5	64,121	3381	35.2	1,138	99.99	340
6	2,956	3285	34.8	54	99.99	15
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	30,199	3050	43.3	594	99.99	197
12	71,924	3003	42.9	1,437	99.99	465
13	74,856	3126	40.0	1,437	99.99	450
14	75,041	3127	39.7	1,440	99.99	448
15	74,559	3131	40.3	1,429	99.99	452
16	74,069	3249	40.6	1,368	99.99	453
17	81,664	3434	41.0	1,427	99.99	504
18	80,664	3361	41.8	1,440	99.99	508
19	79,543	3394	41.1	1,406	99.99	492
20	46,691	3569	42.4	785	99.99	298
21	83,276	3470	39.2	1,440	99.99	491
22	81,384	3427	39.5	1,425	99.99	484
23	81,199	3383	40.5	1,440	99.99	496
24	83,073	3461	39.8	1,440	99.99	497
25	83,083	3471	38.9	1,436	99.99	486
26	83,340	3472	38.4	1,440	99.99	481
27	82,749	3465	38.4	1,433	99.99	478
28	82,595	3441	40.5	1,440	99.99	503
29	81,193	3383	38.0	1,440	99.99	464
30	76,059	3356	35.3	1,360	99.99	404
31	79,531	3337	39.8	1,430	99.99	477

Total CO_2 Equivalent Reduced (tCO_2e)	**11,656**
CO_2 Emission Intensity (5) (tCO2e/MWh)	**0.489**
Quantity of Electricity Imported (MWh)	**2.0**
CO_2 Emissions Produced (tCO_2e)	**1**
Total CO_2 Equivalent Reduced (tCO_2e)	**11,655**

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) Default emission factor for the Brazilian North-Northeast interconnected grid