MONITORING REPORT FORM (CDM-MR)
Version 01 - in effect as of: 28/09/2010

CONTENTS

MONITORING REPORT
Version 6 24/12/2012

Bionersis project Thailand 1
2514
Monitoring period 2 – 01/01/2011 – 31/12/2011

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

The current project activity is a landfill gas collection and flaring system.

1. the project activity aims at recovering and flaring the landfill gas (LFG) produced by the landfill of Kamphaeng Saen (KPS) near Bangkok; by flaring the LFG, the methane contained in the LFG is destroyed and indeed greenhouse gas emissions are reduced;
2. the technology and equipments installed on site are:
   - a gas collection network, permeable pipes and vertical gas wells
   - a high temperature enclosed flare
   - monitoring and control system
3. the project was commissioned on 26 March 2010 and started recording values on 1 April 2010; it has been continuously operating since then;
4. total emission reductions achieved in this monitoring period: 30,645 tCO_2e

A.2. Project Participants

Party	Project Participant
Thailand (host country)	Bionersis (Thailand) Ltd.
France	Bionersis S.A.
Netherlands	E.ON Carbon Sourcing GmbH

A.3. Location of the project activity:

The landfill is located at T. Sa Si Mum, Kamphaeng Saen, province of Nakhon Pathom, in Thailand. Its geographic coordinates are 14°03’36” North, 99°58’01” East.

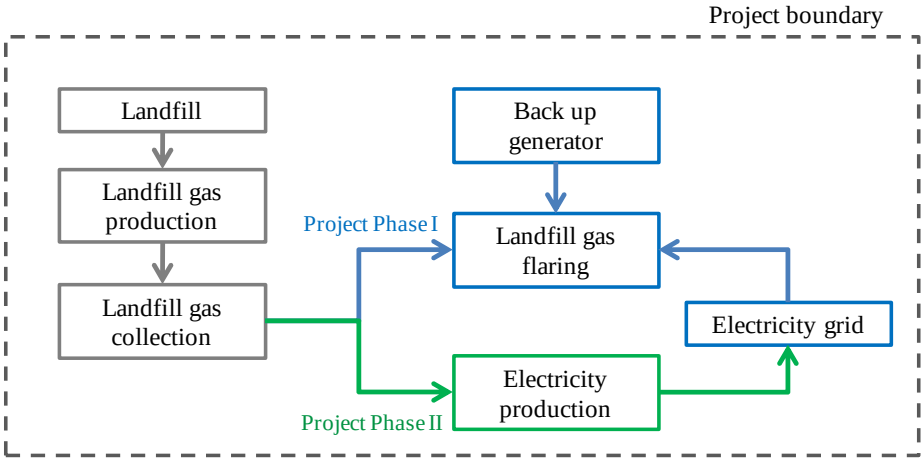
A.4. Technical description of the project

The technology applied in the project activity is a landfill gas collection and flaring system.
The two pictures below schematize the situation of the landfill before and after implementation of the project activity:

The equipment installed includes:

1. a gas collection network consisting of vertical gas wells and a main collector
2. a high temperature enclosed flare manufactured by the UK company Organics, type SC4000 of 4,000 Nm^3/h capacity
3. measuring equipments and control system: see details in section C

Project boundaries diagram (Note: phase II has not been implemented yet and during the current monitoring period, no backup generator was used: electricity was imported from the grid):



A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

Large-scale methodology ACM0001 ver. 8 – "*Consolidated baseline and monitoring methodology for landfill gas project activities*" has been applied to the project.

The other methodological tools used are:
"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" (version 4, EB41)
"Tool to determine project emissions from flaring gases containing methane" (version 1, EB28)
"Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1, EB39)

A.6. Registration date of the project activity:

24/09/2009

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Fixed crediting period: 01/04/2010 -31/03/2020
Changed from 01/12/2009 - 30/11/2019

A.8. Name of responsible person(s)/entity(ies):

Bionersis S.A. : 149 , rue Montmartre, 75002 Paris, France
Telephone: +33 960088849 Fax: +33 140289663

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

The project was commissioned on 26 March 2010 and started recording values since 1 April 2010.

1. The starting date of operation of the project activity is 01/04/2010.
2. During the monitoring period, the electricity used for the project activity was imported from the grid.
   During the monitoring period, there was one major shutdown events between 05 April to 07 April 2011 for the purpose of relocation of the main collector.
   Some equipment was replaced: gas analyzers' cells, temperature and pressure sensors, thermocouple and flow meter.
3. No event or situation which may impact the applicability of the methodology occurred during the monitoring period.
4. The development of project phase II, electricity generation, is still under consideration. PPs have obtained a quotation from the perspective power generator supplier and have signed the power purchase agreement with the Provincial Electricity Authority of Thailand.

B.2. Revision of the monitoring plan

NA

B.3. Request for deviation applied to this monitoring period

NA

B.4. Notification or request of approval of changes

NA

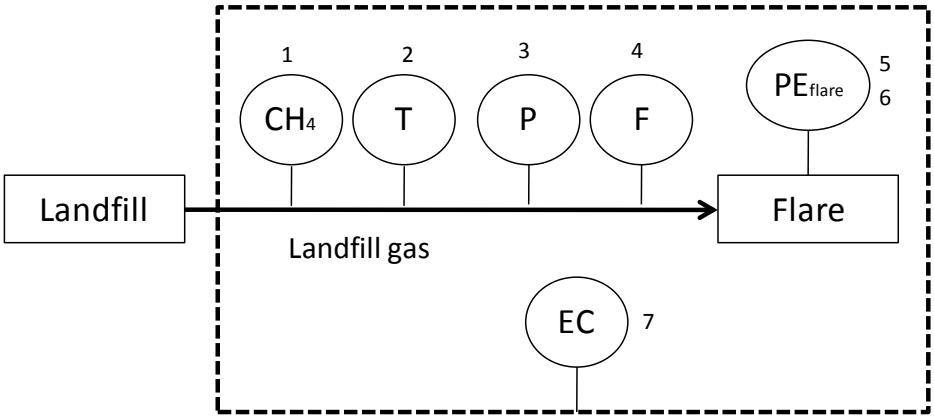
SECTION C. Description of the monitoring system

C.1.MONITORING EQUIPMENT

C.1.1.Measuring equipment

1. gas analyzer
2. temperature sensor
3. pressure sensor
4. flow meter
5. thermocouple
6. exhaust gas analyser
7. electricity meter

The following diagram shows the relevant monitoring points:



C.1.2.Data acquisition and storage system

The data measured by the instruments are collected in a data acquisition system called "Memograph" manufactured by Endress+Hauser. The Memograph is equipped with a flash memory card of 256 MB for data storage. The data stored on the memory card is retrieved via USB.
Manufacturer and model: Endress+Hauser Memograph M Graphic Data Manager RSG40
Serial number: D2007B04267

C.2.MONITORING SYSTEMS AND PROCEDURES

C.2.1.Data logging, transmission, processing and storage

The data trail from monitored parameters to emissions reductions calculations is a semi-automated process, designed to prevent tempering of the raw data and to allow transparent control of the results.

1.Downloading the monitored data (raw data .RSD format)
The monitored data are recorded by the data logger system every minute under the encrypted .RSD format, which is a binary program that only the ReadWin2000 program can read.
At regular interval (weekly, monthly or on demand) the Monitoring and Maintenance Manager downloads the data via a USB interface on site. The downloaded .RSD files are stored in the central server.

2.Extracting the data (raw data .XLS format)
An extraction to .XLS of monitored data is used as input by the CER calculator program.

3.Calculating the data (CER calculations)
The input .XLS file extracted from Readwin is processed into a CER calculator program[1] that takes into account formulas and parameters applicable as per the PDD/methodology.
The CER output file is encrypted: the calculator includes a program that generates a random password. Indeed, no one can unprotect it[2].

C.2.2.Managerial responsibilities

- The CDM aspects of the project are managed by the CDM Director and the CDM Project Manager, who is in charge of preparing the monitoring report.
- The Monitoring and Maintenance Manager is accountable for the monitoring activities, the logging and record keeping of all monitored data. He/she supervises the calibration and maintenance procedures.
- Maintenance programs are carried out on site by the Field Technician, who also ensures that the monitoring equipment operates correctly.

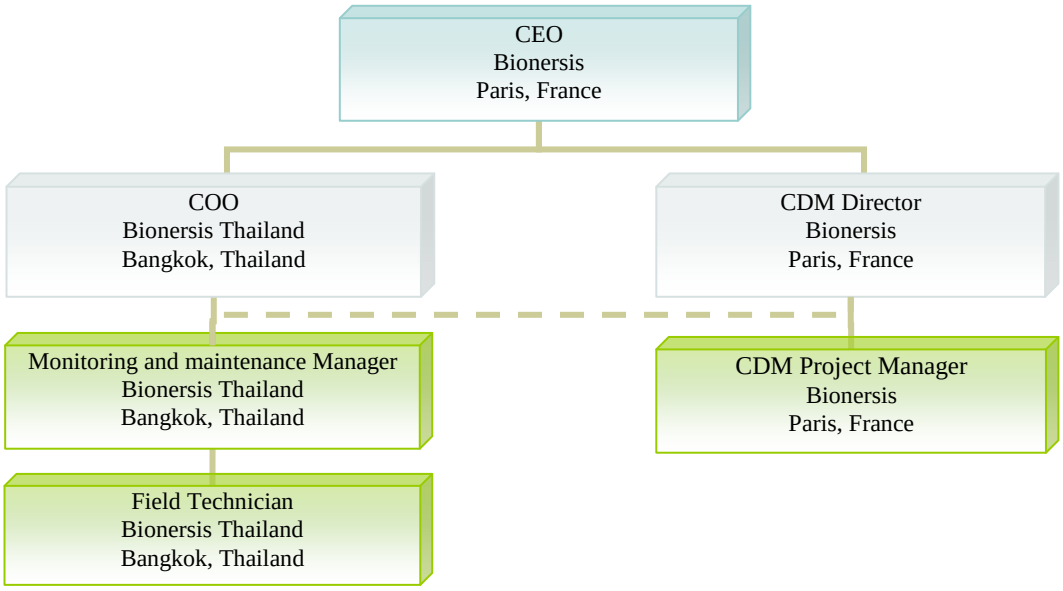


Figure – Managerial organization

C.2.3.Quality assurance and quality control

1.Control of the monitored parameters

[1] Disclaimer: note that the CER calculator program works with MS Excel 2007 but not with anterior versions of MS Excel. Also note that macro must be enabled.

[2] Note that to be compliant with the completeness check of requests for issuance requirements (EB48 Annex 68 paragraph 9b), an unprotected version of the spreadsheets can be made available for the UNFCCC revision

The values recorded by the monitoring instruments are controlled at 3 stages:

- A first control happens on site, when collecting data and reporting events
- Then a second check takes place at the time of uploading values to the server machine and to the on-line database
- The final validation is the responsibility of the monitoring and maintenance manager who analyses the events, cross-check the consistency of data and eventually takes action if necessary

2.Quality control

On a monthly basis, the CDM team based in France checks the quality of information provided by local teams on site. This remote internal audit ensures the compliance of operations with CDM requirements.

3.Training

Employees involved in the monitoring were trained externally and internally on the following topics:

- Review of equipment and captors
- Configuration of monitoring equipment
- Calibration and maintenance requirements

4.Emergency procedures

Emergency procedures are described in an internal document which includes role and responsibilities of personnel, definition of risks, description of emergency equipment, risk assessment, emergency plan in case of fires, explosion, accident etc.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2/tCH_4
Description:	Global warming potential of CH_4
Source of data used:	Defined by the IPCC methodology
Value :	21
Indicate what the data are used for:	Baseline emissions calculations
Additional comment:	

Data / Parameter:	**D_{CH4}**
Data unit:	t_{CH4}/m^3_{CH4}
Description:	Density of methane
Source of data used:	Methodology
Value :	0.0007168
Indicate what the data are used for :	Baseline emissions calculations
Additional comment:	

Data / Parameter:	**AF**
Data unit:	%
Description:	Adjustment factor
Source of data used:	Common practice, on-site assessment, regulation
Value :	0%

Indicate what the data are used for:	Baseline emissions calculations
Additional comment:	

Data / Parameter:	**EF_{EL}**
Data unit:	tCO_2e/MWh
Description:	CO_2 emission factor of the Thai grid
Source of data used:	*Tool to calculate the emissions factor for an electric system*
Value :	0.610
Indicate what the data are used for:	Project emissions calculations
Additional comment:	Calculated ex-ante in the registered PDD and fixed during the crediting period

Data / Parameter:	**TDL**
Data unit:	%
Description:	Technical transmission and distribution losses in the grid
Source of data used:	Tool to calculate baseline, project and/or leakage emissions from electricity consumption
Value :	20%
Indicate what the data are used for:	Project emissions calculations
Additional comment:	Default value

D.2. Data and parameters monitored

Data / Parameter:	**LFG_{flare}**
Data unit:	Nm^3
Description:	Amount of landfill gas captured and flared at normal temperature and pressure
Measured /Calculated /Default:	Measured
Source of data:	Data logger
Value(s) of monitored parameter:	Values are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Flow meter Manufacturer: Elster Instromet Type: turbine gas flow meter Model: Q75 DN300 4000 Accuracy: ±1.5% for $0.2Q_{max}$ to Q_{max} ±3.0% for Q_{min} to $0.2Q_{max}$ where Q_{min} = 200, Q_{max} = 4000 Serial number: 10514495 and 10514496 The meter n° 10514495 was replaced by n° 10514496 on 12/05/2011. Calibration frequency: every three years Last calibration: both meters were calibrated by the manufacturer prior to the installation in the plant on 27/01/2010 (calibration report n°753170-10 for both meters)

	Validity: n° 10514495 26/03/2010-26/03/2013 (calibration valid for 3 years from the commissioning) n° 10514496 12/05/2011-12/05/2014 (calibration valid for 3 years from the installation in the plant)
Measuring/ Reading/ Recording frequency:	Measured and recorded every minute
Calculation method (if applicable):	Normalized flow is calculated automatically by the data logger (Memograph) which processes the flow, temperature and pressure to output the gas flow in Nm^3/h (see more information on the Memograph section C.1.2).
QA/QC procedures applied:	Regular maintenance

Data / Parameter:	**T**
Data unit:	°C
Description:	Temperature of the landfill gas
Measured /Calculated /Default:	Measured
Source of data:	Data logger
Value(s) of monitored parameter:	Values are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Baseline emission calculations (normalization of flow)
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Temperature sensor Manufacturer: H&b Sensors Model: STD-527 / PtR100 Accuracy: class B ±0.3°C + 0.005[t°] Serial number: 72529-03 and 72529-02 Sensor n° 72529-03 was replaced by n° 72529-02 on 16/03/2011. Calibration frequency: every year Last calibration: both sensors were calibrated by the manufacturer prior to the installation in the plant on 04/03/2010 (calibration certificate n° 000001438 for both sensors) Validity: n° 72529-03 26/03/2010-26/03/2011 (calibration valid for 1 year from the commissioning) and n° 72529-02 16/03/2011-16/03/2012 (calibration valid for 1 year from the installation in the plant).
Measuring/ Reading/ Recording frequency:	Measured and recorded every minute
Calculation method (if applicable):	Normalized flow is calculated automatically by the data logger which processes the flow, temperature and pressure to output the gas flow in Nm^3/h. See more information in LFG_{flared} table.
QA/QC procedures applied:	Regular maintenance

Data / Parameter:	**P**
Data unit:	mbar
Description:	Pressure of the landfill gas
Measured /Calculated /Default:	Measured

Source of data:	Data logger
Value(s) of monitored parameter:	Values are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Pressure sensors: gauge + atmospheric Gauge Manufacturer: Sensit / Rox Spur Measurement & Control Ltd Model: HPS-A series Accuracy: class C ±1% Serial number: 421922, 421921, and 421919 The sensor n° 421921 was used to replace n° 421922 between 16/03/2011-20/03/2011. The sensor n°421922 was replaced again by n°421919 on 26/03/2011. Calibration frequency: every year Calibration: All of the gauge pressure sensors were calibrated by the manufacturer prior to the installation in the plant on 29/01/2010 (calibration certificate n° Sira 02ATEX2386X) Validity: n°421922 26/03/2010-26/03/2011 (calibration valid for 1 year from the commissioning), n°421922 16/03/2011-16/03/2012 (calibration valid for 1 year from the installation in the plant), and n°421919 26/03/2011-26/03/2012 (calibration valid for 1 year from the installation in the plant). Atmospheric Manufacturer: Sensit / Rox Spur Measurement & Control Ltd Model: HPS-A series Accuracy: class C ±1% Serial number: 421916 and 437830 The sensor n°421916 was replaced by n°437830 on 16/03/2011. Calibration frequency: every year Calibration: the sensors were calibrated by the manufacturer prior to the installation in the plant on 29/01/2010 and 10/08/2010 (calibration certificate n° Sira 02ATEX2386X) Validity: n°421916 26/03/2010-26/03/2011 (calibration valid for 1 year from the commissioning) and n°437830 16/03/2011-16/03/2012 (calibration valid for 1 year from the installation in the plant).
Measuring/ Reading/ Recording frequency:	Measured and recorded every minute
Calculation method (if applicable):	Normalized flow is calculated automatically by the data logger which processes the flow, temperature and pressure to output the gas flow in Nm^3/h. See more information in LFG_{flared} table.
QA/QC procedures applied:	Regular maintenance

Data / Parameter:	w_{CH4}
Data unit:	% (m^3CH_4/m^3LFG)
Description:	Methane fraction in the landfill gas
Measured /Calculated /Default:	Measured

Source of data:	Data logger
Value(s) of monitored parameter:	Values are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Gas analyzer Manufacturer: Edinburgh Instruments/ Model: Gas card NG Accuracy: ±2% Serial number: 26698 and 150. The Gas card n°26698 was replaced by n°150 on 14/01/2011. Calibration frequency: see calibration dates in appendix 1 Last calibration: see calibration dates in appendix 1 Initial calibration: Gas card n° 26698 and 150 were calibrated by the manufacturer prior to the installation in the plant on 08/12/2009 and 26/10/2010, respectively (calibration certificates n°881 and 1046) Validity: calibration valid until the end of the current monitoring period (the manufacturer's recommendation on calibration frequency is one year).
Measuring/ Reading/ Recording frequency:	Measured and recorded every minute
Calculation method (if applicable):	Not calculated
QA/QC procedures applied:	The gas analyzer is calibrated by comparison with certified gas cylinders. Certified gas cylinders used for the comparison during the monitoring period include: Cylinder 45.15% CH_4 n° K05601 supplied by Air Liquide Cylinder 20.04% O_2 n° K39551 supplied by Air Liquide (used as zero gas for calibrations between 01/01/2011-10/04/2011). Cyliner 99.999% N_2 supplied by Air Liquide (used as zero gas for calibrations between 11/04/2011-31/12/2011).

Data / Parameter:	**EC_{PJ}**
Data unit:	MWh
Description:	Quantity of electricity consumed by the project activity during the monitoring period
Measured /Calculated /Default:	Measured
Source of data:	Continuously measured by electricity meter. Daily manual records
Value(s) of monitored parameter:	37.997 MWh
Indicate what the data are used for:	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Electricity meter Manufacturer: Schneider Electric Model: PM710MG Accuracy: 2% (class 2) Serial number: 44ECB945 Calibration frequency: every 3 years

	Last calibrations: tested and calibrated by the manufacturer prior to the installation in the plant (statement of calibration and test dated 25/03/2010) and re-calibrated on 22/07/2010 (calibration certificate n°0203EL10) Validity: 22/07/2010 – 22/07/2013
Measuring/ Reading/ Recording frequency:	Measuring every second. Reading and recording every day.
Calculation method (if applicable):	Not calculated
QA/QC procedures applied:	Cross check with the electricity purchase invoices

Data / Parameter:	**$PE_{flare,y}$**
Data unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in the year *y*
Measured /Calculated /Default:	Calculated
Source of data:	Calculated according to *Tool to determine project emissions from flaring gases containing methane*
Value(s) of monitored parameter:	Values of monitored parameters are provided in spreadsheets aggregated every month. Project emissions from flaring are calculated on an hourly basis. Aggregated value for $PE_{flare,y}$ for the monitoring period is calculated as 3,964.17 tCO_2 (see note below).
Indicate what the data are used for:	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare}
Measuring/ Reading/ Recording frequency:	Recording of the parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare} every minute. PE_{flare} calculated for the monitoring period.
Calculation method (if applicable):	Calculated according to *Tool to determine project emissions from flaring gases containing methane*
QA/QC procedures applied:	See parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare}.

Data / Parameter:	**$\eta_{flare,h}$**
Data unit:	%
Description:	Flare efficiency in hour *h*
Measured /Calculated /Default:	Calculated (see note below)
Source of data:	Calculated according to *Tool to determine project emissions from flaring gases containing methane*
Value(s) of monitored parameter:	Values of monitored parameters are provided in spreadsheets aggregated every month.
Indicate what the data are used for:	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration	See parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare}

frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Recording of the parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare} every minute. η_{flare} calculated every hour (see note below)
Calculation method (if applicable):	Calculated according to *Tool to determine project emissions from flaring gases containing methane*
QA/QC procedures applied:	See parameters $fv_{CH4,h}$, $FV_{RG,h}$, $t_{O2,h}$, $fv_{CH4,FG,h}$ and T_{flare}.

Data / Parameter:	**T_{flare}**
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare
Measured /Calculated /Default:	Measured
Source of data:	Data logger
Value(s) of monitored parameter:	Values of monitored parameters are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Thermocouple Manufacturer: Thermology Co. Ltd. Type N Accuracy: ±2.2°C or 0.75% of reading whichever is larger Serial number: TT-4638-1 and TT-4638-3 The device n° TT-4638-1 was replaced by n° TT-4638-3 on 16/03/2011. Calibration frequency: calibrated or replaced every year Last calibration: both thermocouples were calibrated by the manufacturer prior to the installation in the plant on 03/02/2010 (certificate n°10/0269 and n°10/0271, respectively) Validity: n° TT-4638-1 26/03/2010-26/03/2011 (calibration valid for 1 year from the commissioning) and n° TT-4638-3 16/03/2011-16/03/2012 (calibration valid for 1 year from the installation in the plant).
Measuring/ Reading/ Recording frequency:	Measuring and recording every minute
Calculation method (if applicable):	Not calculated
QA/QC procedures applied:	Calibrated or replaced every year

Data / Parameter:	**$t_{O2,h}$**
Data unit:	-
Description:	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour *h*
Measured /Calculated /Default:	Measured
Source of data:	Data logger
Value(s) of monitored parameter:	Values of monitored parameters are provided in spreadsheets aggregated every month
Indicate what the data are	Project emission calculations (see note below)

used for:	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Gas analyzer Manufacturer: City Technology Model: T7OX Oxigen CITIceL® Transmitter Accuracy: 1% Serial number: 15556996, 15557003, 15556997 and 17035465 The gas card n°15556996 was replaced by n°15557003 on 14/01/2011. The gas card n°15557003 was replaced by n°15556997 on 31/01/2011. The gas card n°15556997 was replaced by n°17035465 on 07/02/2011. Last calibration: see calibration dates in appendix 1 Initial calibration: the analyzers n° 15556996, 15557003 and 15556997 were calibrated by the manufacturer prior to the installation in the plant on 27/01/2010 (calibration certificates n° 115949). The analyzer n°17035465 was calibrated by the manufacture prior to the installation in the plant on 09/11/2010 (calibration certificate n°126472). In addition, the analyzers n°15557003 and n°17035465 were also calibrated at the date of installation at the plant on 14/01/2011 and 07/02/2011 respectively. And the analyzer n°15556997 was calibrated on 03/01/2011. Validity: calibration valid during the entire monitoring period (the manufacturer's recommendation on calibration frequency is one month).
Measuring/ Reading/ Recording frequency:	Measuring and recording every minute
Calculation method (if applicable):	Not calculated
QA/QC procedures applied:	A zero check and a typical value check are performed by comparison with a standard gas. Certified gas cylinders used for the comparison during the monitoring period include: Cylinder 20.04% O_2 n° K39551 Cylinder 4.54% CH_4 n° K05685 (used as zero gas for calibrations between 01/01/2011-10/04/2011). Cylinder 99.999% N_2 (used as zero gas for calibrations between 11/04/2011-31/12/2011).

Data / Parameter:	$\mathbf{fv_{CH4,FG,h}}$
Data unit:	mg/m^3
Description:	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
Measured /Calculated /Default:	Measured
Source of data:	Data logger
Value(s) of monitored parameter:	Values of monitored parameters are provided in spreadsheets aggregated every month
Indicate what the data are used for:	Project emission calculations (see note below)
Monitoring equipment (type,	Gas analyzer

accuracy class, serial number, calibration frequency, date of last calibration, validity)	Manufacturer: Edinburgh Instruments Model: Gas card NG Accuracy: ±2% Serial number: 697 and 289 The gas card n°697 was replaced by gas card n°289 on 29/08/2011. Calibration frequency: see calibration dates in appendix 1 Last calibration: see calibration dates in appendix 1 Initial calibration: calibrated by the manufacturer prior to the installation in the plant on 30/08/2010 for Gas card n°697 and on 26/10/2010 for Gas card n°289 (calibration certificates n°1013-B and 1045, respectively) Validity: calibration valid during the entire monitoring period (the manufacturer's recommendation on calibration frequency is one year).
Measuring/ Reading/ Recording frequency:	Measuring and recording every minute
Calculation method (if applicable):	Not calculated
QA/QC procedures applied:	A zero check and a typical value check are performed by comparison with a standard gas. Certified gas cylinders used for the comparison during the monitoring period include: Cylinder 4.54% CH_4 n° K05685 Cylinder 20.04% O_2 n° K39551 (used as zero gas for calibrations between 01/01/2011-10/04/2011). Cylinder 99.999% N_2 (used as zero gas for calibrations between 11/04/2011-31/12/2011).

It should be noted that for this particular monitoring period, although the parameters $\mathbf{t_{O2,h}}$ and $\mathbf{fv_{CH4,FG,h}}$ had been monitored, but they are not used for the calculation of parameters $\boldsymbol{\eta}_{\mathbf{flare,h}}$ and thus $\mathbf{PE_{flare,y}}$.
To be conservative, the PP uses the default values of flare efficiency as per stipulated in the *Tool to determine project emissions from flaring gases containing methane* (see details in section E.1.) for calculation of the project emission reductions.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

The monitoring methodology is based on direct measurement of the amount of landfill gas captured and destroyed at the flare.

Emissions reduction (ER_y)

$$\mathbf{ER_y = (MD_{project,y} - MD_{BLy}) * GWP_{CH4} - PE_{,y}}$$

Where:

$\mathbf{MD_{project,y}}$ Amount of methane that would have been destroyed/combusted during the year *y*, in tons of methane (tCH_4) in project scenario

$\mathbf{MD_{BL,y}}$	Amount of methane that would have been destroyed/combusted during the year *y* in the absence of the project due to regulatory and/or contractual requirement, in tons of methane (tCH_4)
$\mathbf{GWP_{CH4}}$	Global Warming Potential value for methane
$\mathbf{PE_y}$	Project emissions consist of CO_2 emissions related to the power used by the project activity facilities. Project emissions result from electricity consumption, $PE_y = PE_{EC,y}$

Methane destroyed by LFG flaring ($MD_{project,y}$)

During the considered monitoring period, all LFG captured was flared, thus $MD_{project} = MD_{flared}$

$$\mathbf{MD_{project,y} = (LFG_{flare,y} * w_{CH4} * D_{CH4}) – (PE_{flare,y}/GWP_{CH4})}$$

Where:

$LFG_{flare,y}$	landfill gas flared in the year *y* (m^3)
w_{CH4}	methane content in landfill gas in the year *y* (mass fraction)
D_{CH4}	Methane density expressed in t_{CH4}/m^3_{CH4}
$PE_{flare,y}$	Emissions from flaring of the residual gas stream in year *y* (tCO_2)
GWP_{CH4}	Global Warming Potential value for methane

Methane destroyed in the absence of the project ($MD_{BL,y}$)

As per the PDD, $\mathbf{MD_{BL,y} = MD_{project,y} * AF}$, where AF is set as 0%

Flare efficiency (PE_{flare} or $\eta_{flare,h}$)

During the considered monitoring period, although the parameters required to calculate the hourly flare efficiency are recorded every minute to allow the continuous monitoring of the methane destruction efficiency of the flare (flare efficiency PE_{flare} or $\eta_{flare,h}$), but since the traversing measuring procedure was not implemented to confirm the uniformity of the methane composition throughout the sampling section as per recommended in AM_CLA_0047, therefore PP decided to take a conservative approach by applying the following default values for $\eta_{flare,h}$, which is in accordance with *Tool to determine project emissions from flaring gases containing methane*:

- 0% if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour *h*.
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h*, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*.
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*.

According to the manufacturer's specifications, the correct operation of the flare is verified by the combustion temperature above 500°C. The combustion temperature is measured by the N-type thermocouple and recorded by the data logger every minute.

The formula used are as described in the PDD and the tool and can be verified in the excel spreadsheets provided for verification.

Formula used for PE_{flare} :

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$

Where:

$TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h (kg/h)

Formula used for $\eta_{flare,h}$:

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$$

Where:

$TM_{FG,h}$ Methane mass flow rate in exhaust gas averaged in the hour h (kg/h)

However as mentioned above, for this monitoring period the PP applied the default values for parameter $\eta_{flare,h}$.

E.2. Project emissions calculation

Project emissions resulting from electricity consumption are calculated as:

$PE_{EC,y} = EC_{PJ,y} * EF_{EL,y} * (1+TDL)$

Where:

$EC_{PJ,y}$ Quantity of electricity consumed by the project activity during year *y* (in MWh)

$EF_{EL,y}$ CO_2 emissions intensity of the electricity consumed by the project activity, ex-ante calculated and fixed as 0.610 tCO_2/MWh

TDL Average technical transmission and distribution losses in the grid in year *y* for the voltage level at which electricity is obtained from the grid at the project site, use of default value 20%

It should be noted that the value of EC is aggregated for the entire monitoring period and calculated once for the period.

E.3. Leakage calculation

Not applicable.

E.4. Emission reductions calculation / table

Total of the emission reductions achieved during the monitoring period:

$MD_{project}$ (tCH_4)	**MD_{BL} (tCH_4)**	**PE_{EC} (tCO_2e)**	**Leakage**	**Emissions reductions (tCO_2e)**
$MD_{project,y} = LFG_{flare,y} * w_{CH4} * D_{CH4} - (PE_{flare}/GWP_{CH4})$	$MD_{BL} = MD_{project} * AF$	$PE_{EC} = EC_{PJ} * EF_{EL} * (1+TDL)$	N/A	$ER = (MD_{project} - MD_{BL}) * GWP_{CH4} - PE_{EC}$
1,460.62	00.00	27.81	-	30,645. 21

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
140,279	**30,645**

E.6. Remarks on difference from estimated value in the PDD

The actual emission reductions achieved during the current monitoring period are lower than the values calculated ex-ante in the registered CDM-PDD.
The main reasons might be a combination of:

- high leachate level, which reduces the efficiency of the LFG collection.
- heavy rains in the months considered in the second monitoring report, which caused high level of humidity in the gas and formation of leachate inside the wells and collection network, therefore partly blocking the LFG extraction.

Appendix 1

Calibration dates gas analyzers: It should be emphasized that the information on additional manufacturer's calibrations carried out prior to installation in the plant is described in the Tables of section D.2.

Date	LFG gas analyzer		Exhaust gas analyzer	
	Serial No	Calibrated by	Serial No	Calibrated by
27 Dec 10	26698	BIONERSIS	697 (CH_4) and 15556996 (O_2)	BIONERSIS
03 Jan 11	26698	BIONERSIS	697 (CH_4) and 15556996, and 15556997 (O_2)	BIONERSIS
14 Jan 11	-	-	697 (CH_4) and 15557003 (O_2)	BIONERSIS
07 Feb 11	150	BIONERSIS	697 (CH_4) and 17035465 (O_2)	BIONERSIS
28 Feb 11	150	BIONERSIS	697 and 17035465	BIONERSIS
21 Mar 11	150	BIONERSIS	697 and 17035465	BIONERSIS
18 Apr 11	150	BIONERSIS	697 and 17035465	BIONERSIS
16 May 11	150	BIONERSIS	697 and 17035465	BIONERSIS
30 May 11	150	BIONERSIS	697 and 17035465	BIONERSIS
27 Jun 11	150	BIONERSIS	697 and 17035465	BIONERSIS
11 Jul 11	150	BIONERSIS	697 and 17035465	BIONERSIS
01 Aug 11	150	BIONERSIS	697 and 17035465	BIONERSIS
15 Aug 11	150	BIONERSIS	697 and 17035465	BIONERSIS
29 Aug 11	-	-	289 (CH4)	Edinburgh Instruments
05 Sep 11	150	BIONERSIS	289 and 17035465	BIONERSIS
19 Sep 11	150	BIONERSIS	289 and 17035465	BIONERSIS
17 Oct 11	150	BIONERSIS	289 and 17035465	BIONERSIS
07 Nov 11	150	BIONERSIS	289 and 17035465	BIONERSIS
21 Nov 11	150	BIONERSIS	289 and 17035465	BIONERSIS
12 Dec 11	150	BIONERSIS	289 and 17035465	BIONERSIS
26 Dec 11	150	BIONERSIS	289 and 17035465	BIONERSIS
02 Jan 12	150	BIONERSIS	289 and 18025346	BIONERSIS