**MONITORING REPORT FORM (CDM-MR)**
**Version 01 - in effect as of: 09/12/2010**

## CONTENTS

**MONITORING REPORT**
**Version number 01 of 09/12/2010**

**Quezon City Controlled Disposal Facility Biogas Emission Reduction Project (QCCDFBERP)**
**CDM Registration Reference number 1258**
**5th Monitoring Period: 01/04/2010 – 30/09/2010**

## SECTION A. General description of the project activity

### A.1. Brief description of the project activity:

The Project activity involves the extraction, collection, processing and flaring, including the conversion into electricity of the biogas emissions at the Quezon City Controlled Disposal Facility ("Facility") located in Area 2, Barangay Payatas, Quezon City, Philippines. This project activity was developed primarily to address the environment, health and safety concerns of the local government of Quezon City for its constituents, particularly those residing in the immediate surroundings of the Facility.
The project will be implemented in two phases. During phase 1, the combustion plant will be composed of a biogas extraction system (wells and blower), a high-temperature torch for flaring the methane extracted and an electrical engine for on-site power supply. The electrical engine will be fed by biogas during plant operation (about 8,000 hours/year). An electrical connection to the local grid will be provided in order to supply electricity requirement of the plant during engine maintenance and start-up operations. Phase 2 will begin on the next year (phase 2 will include, depending from the availability of biogas and the technical and financial viability, the installation of an additional engine -about 700 kW- as indicated in the PDD).


*Picture 1: flare and biogas plant*

The plant was completed and commissioned in March 2008.
For the current monitoring period (from the 1st April 2010 to the 30th September 2010), the total amount of emission reduction requested is equal to 59,972 CERs.

| A.2. Project Participants | |
|---|---|
| Organization: | Quezon City |
| Street/P.O.Box: | Elliptical Road |
| Building: | Quezon City Hall |
| City: | Quezon City – Metro Manila |
| State/Region: | National Capital Region |
| Postfix/ZIP: | 1101 |
| Country: | Philippines |
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| FAX: | +6329216750 |
| E-Mail: | Pog_jay@yahoo.com |
| URL: | |
| Represented by: | |
| Title: | City Mayor |
| Salutation: | Honorable |
| Last Name: | Belmonte (Jr.) |
| Middle Name: | |
| First Name: | Feliciano |
| Department: | |
| Mobile: | |
| Direct FAX: | |
| Direct tel: | |
| Personal E-Mail: | |

| | |
|---|---|
| Organization: | Pangea Green Energy Philippines, Incorporated |
| Street/P.O.Box: | 24/F Pacific Star Building, Makati Avenue |
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| City: | Makati City |
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| URL: | |
| Represented by: | |
| Title: | President |
| Salutation: | |
| Last Name: | Campos |
| Middle Name: | Fernan |
| First Name: | Jennifer |
| Department: | |
| Mobile: | +639175351030 |
| Direct FAX: | |
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|---|---|
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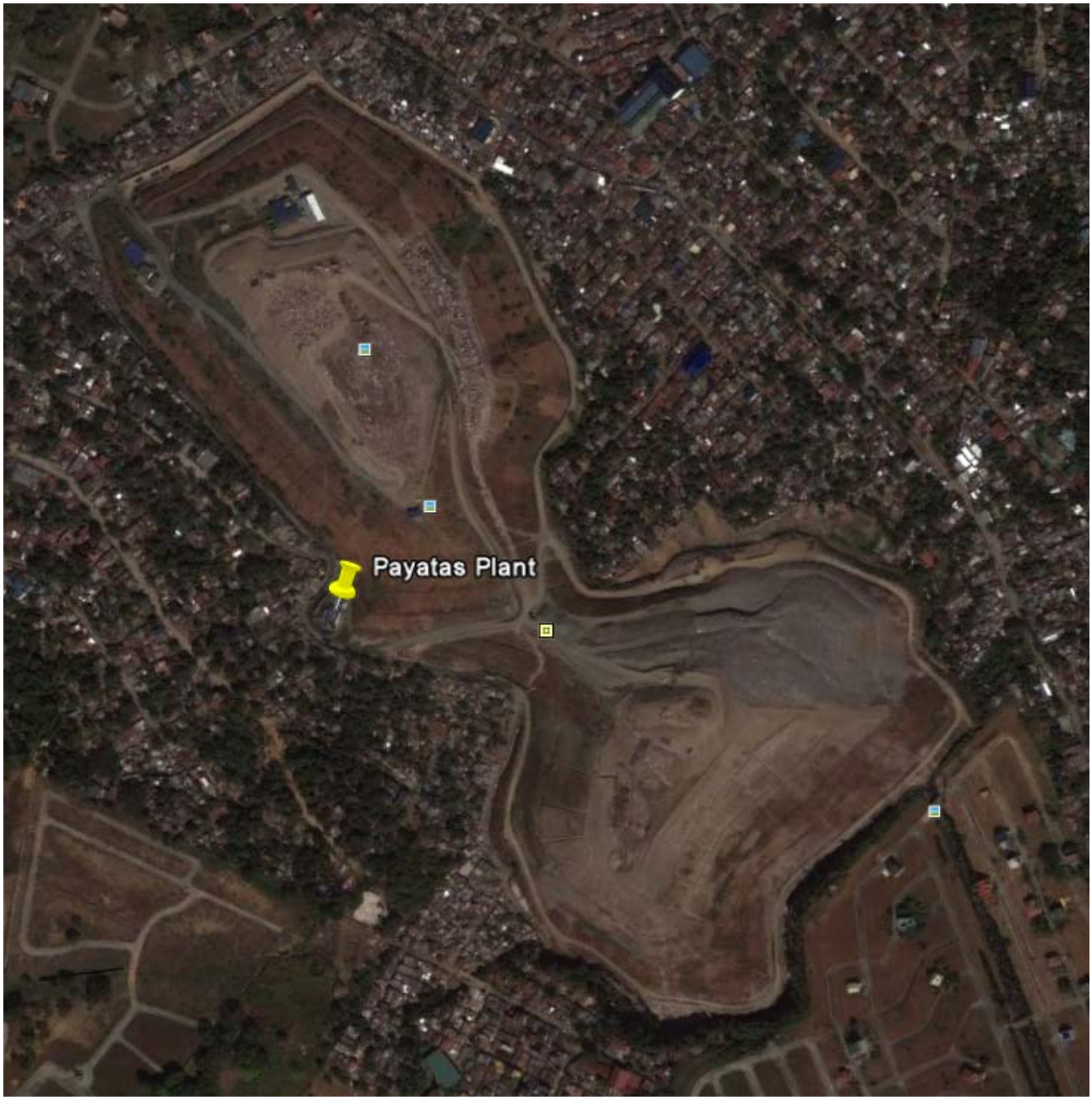
| E-Mail: | info@pangeagreen.biz |
| URL: | www.pangeagreen.biz |
| Represented by: | |
| Title: | Project Manager |
| Salutation: | |
| Last Name: | Ferrero |
| Middle Name: | |
| First Name: | Daniele |
| Department: | |
| Mobile: | +393286690158 |
| Direct FAX: | |
| Direct tel: | |
| Personal E-Mail: | dfe@pangeagreen.biz |

## A.3. Location of the project activity:

Area 2, Barangay Payatas, Quezon City, Metro Manila, Philippines.
GPS coordinates: Latitude: 14.715469° Longitude: 121.104114°




*Picture 2: location of Quezon City Controlled Disposal Facility*

## A.4. Technical description of the project

From the first April 2010 until to the end of September 2010 the network has included 99 wells-trenches (3 were pulled out) divided into two areas of the dumpsite, the Old and New Mound, on a surface of about 22 ha. Wells are around 15-21 meters deep and are approximately 45 meters from each other to achieve optimum efficiency of biogas extraction process.

Each well is connected to a controlling substation (total of 4 units at present); substations convey biogas from each well into main lines up to the extraction plant.

*Picture 3: substation and pipes from wells*

Two extractor fans in parallel, of which one is active and one is on stand-by, allow flow of biogas to the high temperature flare and the electricity generator.
Before going into the electricity generator, the biogas collected passes through a heat exchanger and condensate trap to remove remaining moisture. The most important equipment's characteristics are described in Table 1.

The capacity of the electricity generator presently installed is 200 kW. At present the generator is not capable to run with fossil fuel. Currently, the electricity is produced only for the internal consumption of the plant and for other users (free supplying) in Payatas area (street light, offices, multipurpose hall, dumping areas)

| Equipment | Manufacturer | Type | Technical data |
|---|---|---|---|
| Gas collection network | Various | Wells | • 250 mm pipe slotted<br>• 15-25 m deep<br>• Equipped with well head and regulation valve |
| | | Pipeline | • HDPE material<br>• 90 mm diameter |
| | | Substation | • 5m x 2.5 - 2 arms<br>• Iron anti corrosion painted<br>• Butterfly valve equipped |
| | | Main pipeline | • HDPE material,<br>• 90 mm diameter-160 mm |
| Biogas blower | Continental Industrie | 051A.03 | • Flow: 2,500 $Nm^3/h$<br>• Discharge pressure: 80 mbar<br>• Discharge temp: 56.4 °C<br>• Electric engine supplied also by Continental |

| Equipment | Manufacturer | Type | Technical data |
|---|---|---|---|
| | | | Industrie, 37 kW |
| High temperature enclosed gas flare | Biotecnogas | BTG2500HT | • Capacity 500 – 2,500 $Nm^3/h$<br>• External diam: 2,200 mm<br>• Height 9.50 m<br>• Thickness 150 mm<br>• Material: stainless steel AISI 304<br>• Feeding pressure: 50 mbar<br>• Min $CH_4$ %: 30%<br>• Ratio $CH_4/CO_2>1$<br>• Combustion chamber: refractory made of ceramic fiber modules, thickness 150 mm<br>• Combustion temperature: > 850 C°<br>• Retention time >= 0.3 sec<br>• Critical temperature: 1,260 C°<br>• Combustion coeff. ($CO_2$/ CO + $CO_2$): min 99%<br>• Output signal of the temperature control: continuous, by a thermocouple Pt-Rh-Pt with output signal 4÷20 mA |
| Booster | Mapro | CL 18/01 G | • Nominal flow rate: 150 $Nm^3/h$ ca<br>• Pressure in: 50 mbar<br>• Pressure out: 150 mbar<br>• Power: 3.6 kW ca |
| Engine | Iveco-ATME | Iveco Aifo 8281 | • 8 cylinder turbo engine<br>• Biogas feeding set<br>• Capacity 250 kVA<br>• 1,500 rpm<br>• 400/230 V 50 Hz<br>• 3 phases |

*Table 1*

*Picture 4: plant picture from Old Mound*

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

**A.5.1. Baseline methodology:**

ACM0001 ver. 5 - Consolidated methodology for landfill gas project activities
AMS-I.D. ver. 10 – Grid connected renewable electricity generation
"Tool for the demonstration and assessment of additionality" Version 3
"Tool to determine project emissions from flaring gases containing methane"

**A.5.2. Monitoring methodology:**

ACM0001 ver. 5 - Consolidated methodology for landfill gas project activities
AMS-I.D. ver. 10 – Grid connected renewable electricity generation
"Tool to determine project emissions from flaring gases containing methane"

## A.6. Registration date of the project activity:

1st February 2008

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

The chosen crediting period is of 10 years; it was started on 1st February 2008.

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

This monitoring report was developed and reviewed by:

*Pangea Green Energy srl*
*Biogas Department*
*Corso Vittorio Emanuele II, 83*
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*Loyola Heights, Quezon City 1100 Philippines*
*Mrs. Jenny Fernan Campos*
*President*


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## SECTION B. Implementation of the project activity

### B.1. Implementation status of the project activity

The project started on 18th March 2008

The improvements from the start of plant activities have been directed, for the biogas collection system, to build new wells, horizontal trenches and substation (see Table 2); for the plant the new flow meters in the main, flare and engine line, have been installed to warranty a better reliability, and a new temperature meter has been installed in the flare at the same level of exhausts gas analyzer probe (done in the second verification period).

| Period | Wells | Horizontal trenches | Total | Substation |
|---|---|---|---|---|
| 1st monitoring period (February 1st 2008 - 31 August 2008) | 48 | - | **48** | 3 |
| 2nd monitoring period (1st September 2008 - 30 June 2009) | 64 | - | **64** | 4 |
| 3nd monitoring period (1st July 2009 - 31 December 2009) | 71 | 6 | **77** | 4 |
| 4th monitoring period (1st January 2010 - 31 March 2010) | 71 | 12 | **83** | 4 |
| 5th monitoring period (1st April 2010 – 30 September 2010) | 85 | 14 | **99** | 4 |

*Table 2*

The garbage disposal activity of the Disposal Facility Management Office (POG), requests periodically the partial disconnection of some wells located in the two Mound area ; this situation has caused and causes a loss in biogas production in the areas occupied by dumping activity (is this also the reason for significant less CERs compared to PDD); the lost production is partially recovered through the installation of new wells in elevation, and horizontal trenches. This situation, despite the increasing of wells number, affected negatively the target achieving fixed in the PDD. However from the plant start up, is demonstrable an increasing of the biogas production trend.

The structures for biogas captation have been implemented to partially recover the lost production caused by the waste dumping activity; to support the existing drilled wells we built the increasing wells made for the biogas captation in dumping areas constructed in elevation and the horizontal trenches, with the same function, but made putting horizontal slotted pipes in the waste.

Related of Phase 2 (installation of an additional engine -about 700 kW- as indicated in the PDD) will begin on 2011; the delay related the start of this phase 2 (as described in PDD "*…depending from the availability of biogas and the technical and financial viability*" ….) is connected to the financial capability that was not available during the 2010, because the delay connected to the CERs issuance caused problems to start this development.

Since the beginning of plant operation, gas odor on top of the mounds has been greatly reduced. The subsidence of the garbage mounds was up to 5 meters in just 36 months of gas and leachate extraction. This means that the mounds have a better compaction and the quantity of perched water and leachate was also reduced thereby improving stability of the slopes of the dump. This has allowed a new dumping activity in

the two mounds. Continuous extraction of gas from the dump has reduced the risk of fire and explosion in the area. There were no incidences of fire and explosion due to the project. The plant also supplies free energy for some Payatas users and developed in 2010 a food program in cooperation with NGO for Payatas children.

## B.2. Revision of the monitoring plan

No revision has been made.

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

In the current monitoring period no request for deviation are made.

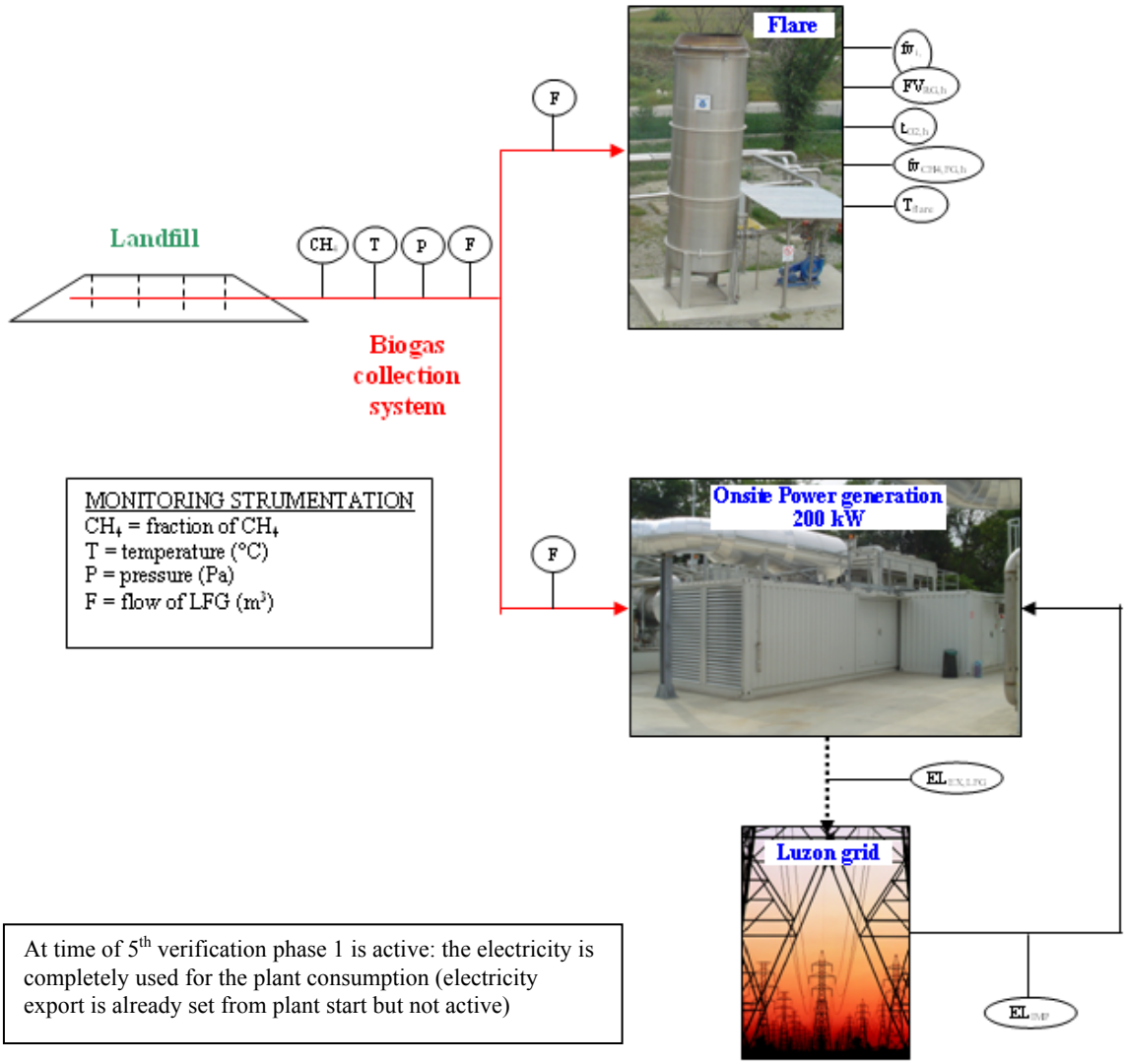
## B.4. Notification or request of approval of changes

No major changes were made.

## SECTION C. Description of the monitoring system

### C.1. Monitoring equipment

The picture below provides schematic information on which monitoring equipment was installed.




*Picture 5: monitoring equipment installed*

**C.1.1. Table providing information on the equipment used for ER calculation (including type, manufacturer, model, serial number, location, information to specific uncertainty, range calibration frequency and last calibration):**

| ID | Type | Manufacturer | Model - Serial Number | Location | Error / Uncertainty | Range | Calibration frequency | Last calibration | Calibration Entity | Oper. period |
|---|---|---|---|---|---|---|---|---|---|---|
| FT03_a | Flow Meter | EMERSON - ROSEMOUNT | 485 - 0075923<br>3051S1CD1A2E12A1AB4D2E1L4Q4 -8696153 | Main pipeline | 0.0087% / 0.025% | 130-2,500 $m^3/h$ | 2 years | 28/2/2009 | EMERSON – PROCESS MANAGEMENT | 1/4/2010 – 30/09/2010 |
| FT04_a | Flow Meter | EMERSON - ROSEMOUNT | 485 - 0075924<br>3051S1CD1A2E12A1AB4D2E1L4Q4 -8696152 | Flare pipeline | 0.01% / 0.025% | 130-2,500 $m^3/h$ | 2 years | 28/2/2009 | EMERSON – PROCESS MANAGEMENT | 1/4/2010 – 30/09/2010 |
| FT05_a | Flow Meter | EMERSON - ROSEMOUNT | 485 - 0075925<br>3051S1CD1A2E12A1AB4D2E1L4Q4 -8696154 | Engine pipeline | 0.01% / 0.025% | 13-250 $m^3/h$ | 2 years | 29/4/2009 | EMERSON – PROCESS MANAGEMENT | 1/4/2010 – 30/09/2010 |
| GA01 | Methane content analyzer | SIEMENS | ULTRAMAT 23 – N1-V7-0538 | Main pipeline | 1% $CH_4$ 0.5% $O_2$ | 0-100% $CH_4$ 0-25% $O_2$ | 1 year | 13/3/2008<br>19/3/2009<br>18/3/2010 | SIEMENS<br>PANGEA AIR LIQ.<br>PANGEA AIR LIQ. | 1/4/2010 – 30/09/2010 |
| TT02 | Temperature meter | ELSI | Probe Model: G1.U10-P20-B0150-S00, Transmitter Model: Y1-SEM203P - Serial number 08-07/305 | Main pipeline | 0.15% / 0.15% | 0-250 °C | 2 years | 12/9/2007<br>10/8/2009 | ELSI Calibration center<br>PREMIER Physic metrologie | 1/4/2010 – 30/09/2010 |
| PT04 | Pressure meter | ABB | 264HS-6407024078 | Main pipeline | 0.40% | 0-250 mbar | 2 years | 25/9/2007<br>10/08/2009 | ABB quality test check<br>PREMIER Physic metrologie | 1/4/2010 – 30/09/2010 |
| TT03 | Temperature meter flare bottom | ELSI | Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 12-08/3358 | Flare bottom | 0.106% / 0.21% | 0-1,600 °C | 2 years | 04/12/2008 | Elsi Calibration center | 1/4/2010 – 30/09/2010 |
| TT05 | Temperature meter flare top | ELSI | Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 10-07/748 | Flare top | 0.14% / 0.30% | 0-1,600 °C | 1 year | 15/12/2007<br>20/8/2008 | Elsi Calibration center<br>PREMIER Physic | 1/4/2010 – 30/09/2010 |

| ID | Type | Manufacturer | Model - Serial Number | Location | Error / Uncertainty | Range | Calibration frequency | Last calibration | Calibration Entity | Oper. period |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | metrologie | |
| | | | | | | | | 10/8/2009 | PREMIER Physic metrologie | |
| | | | | | | | | 12/7/2010 | PREMIER Physic metrologie | |
| GA02 | Exhaust gas analyzer | SIEMENS | ULTRAMAT23 - N1-V0-0038 | Flare | 1% $CH_4$ 0.5 % $O_2$ | 0-100% $CH_4$ 0-25% $O_2$ | 1 year | 13/3/2008 | SIEMENS | 1/4/2010 – 30/09/2010 |
| | | | | | | | | 19/3/2009 | PANGEA AIR LIQ. | |
| | | | | | | | | 18/3/2010 | PANGEA AIR LIQ. | |
| EM01 | Electricity meter | GENIUS | EDMI N680 - 206584765 | Main electrical panel | 0.148% | 5(20) A – 240V | 2 years | 14/3/2007 | ERC Philippines | 1/4/2010 – 30/09/2010 |
| | | | | | | | | 10/3/2009 | ERC Philippines | |
| FT01 | Flow meter line "A"" | EMERSON - ROSEMOUNT | 285G050ZCSP1S17 -0053154 | Line "A | 0.1% | 0-1,200 $m^3/h$ | 2 years | 3/9/2007 | ABB quality test check | 1/4/2010 – 30/09/2010 |
| | | ABB | 264DS - 6407021990 | | | | | 10/8/2009 | PREMIER Physic metrologie | |
| FT02 | Flow meter line "B" | EMERSON - ROSEMOUNT. | 285G050ZCSP1S17 -0050959 | Line "B" | 0.1% | 0-1,200 $m^3/h$ | 2 years | 31/8/2007 | ABB quality test check | 1/4/2010 – 30/09/2010 |
| | | ABB | 264DS - 6407021989 | | | | | 10/8/2009 | PREMIER Physic metrologie | |
| HC01 | Plant hours counter | BIOTECNOGAS | SCADA | Plant pc | --------- | 0-999999 h | Not required | --------- | --------- | 1/4/2010 – 30/09/2010 |

*Table 3*

The flow meters FT01 and FT02 are backup flow meters. Other instrument installed for the plant management (pressure meter lines A and B, pressure meter before the blowers, temperature meter before the blower, portable gas analyzer) but not involved in the ER calculation are described in "QCCDFBERP Monitoring plan"in Annex 2. The calibration frequency of all instruments involved in the ER calculation in is in compliance with "Guidelines for assessing compliance with the calibration frequency requirements" version 01, EB 52 Annex 60.

**C.1.2. Calibration procedures**

See Table 3.

**C.2. Quality assurance and quality control measures**

See "QCCDFBERP Monitoring plan" in Annex 2.

## 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: | t $CO_{2eq}$ |
| Description: | Global Potential Warming of methane |
| Source of data used: | Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996) |
| Value(s) : | 21 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Additional comment: | |

| **Data / Parameter:** | **$D_{CH4}$** |
|---|---|
| Data unit: | $t/m^3$ |
| Description: | Methane density |
| Source of data used: | Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996) |
| Value(s) : | 0.0007168 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Additional comment: | |

| **Data / Parameter:** | **$CEF_{electricity,y}$** |
|---|---|
| Data unit: | t $CO_2$/MWh |
| Description: | $CO_2$ emissions intensity of the electricity displaced |
| Source of data used: | Calculated according to AMS – I.D. Version 10 (see PDD) |
| Value(s) : | 0.46 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Additional comment: | |

| D.2. Data and parameters monitored |
|---|

| Data / Parameter: | $LFG_{total,y}$ |
|---|---|
| Data unit: | $m^3$ |
| Description: | Total amount of landfill gas |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | FT03_a (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 10,100,760 $m^3$ (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | FT03_a. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| Data / Parameter: | $LFG_{flare,y}$ |
|---|---|
| Data unit: | $m^3$ |
| Description: | Amount of landfill gas flared |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | FT04_a (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 9,711,771 $m^3$ (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | FT04_a. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | **$LFG_{electricity,y}$** |
|---|---|
| Data unit: | $m^3$ |
| Description: | Amount of landfill gas combusted in power plant |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | FT05_a (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 258,842 $m^3$ (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | FT05_a. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | **$FV_{RG,h}$** |
|---|---|
| Data unit: | $Nm^3/h$ |
| Description: | Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h* |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Calculation based of LFG, T, P parameters measured |
| Value(s) of monitored parameter: | 1,833 $Nm^3/h$ (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | FT03_a, FT04_a, FT05_a, TT02, PT04. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | Calculation by the normalization formula:<br><br>$FV_{RG,h} = LFG_{flare,h} \times \{[P + p_{atm}) \times T_n] / [P_n \times (T + T_n)]\}$<br><br>where:<br>$T_n = 273.15$ K |

| | |
|---|---|
| | $P_n$ = 1,013.25 mbar |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | **$f_{vCH4,h}$** |
|---|---|
| Data unit: | % |
| Description: | Volumetric fraction of methane in the residual gas in the hour *h* |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | GA01 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 48.624% (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | GA01. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **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: | Directly measured |
| Source of data: | GA02 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 14.051% (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | GA02. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | $f_{vCH4,FG,h}$ |
|---|---|
| Data unit: | $mg/m^3$ |
| Description: | Concentration of methane in the exhaust gas of the flare in dry basis at normal condition in the hour *h* |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | GA02 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 6.790 $mg/m^3$ (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | GA02. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | $T_{flare}$ |
|---|---|
| Data unit: | °C |
| Description: | Temperature in the exhaust gas of the flare |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | TT05 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 663.342 °C (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | TT05. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| Data / Parameter: | T |
|---|---|
| Data unit: | °C |
| Description: | Temperature of the landfill gas |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | TT02 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 68.414 °C (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | TT02. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| Data / Parameter: | P |
|---|---|
| Data unit: | mbar[1] (Pa) |
| Description: | Pressure of the landfill gas |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | PT04 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 46.519 mbar = 4,651.9 Pa (average value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | PT04. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

[1] 1 mbar = 100 Pa

| **Data / Parameter:** | **$EL_{EX,LFG}$** |
|---|---|
| Data unit: | MWh |
| Description: | Total amount of electricity exported out of the project boundary |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | EM01 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 0.010 MWh (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | EM01. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | **$EL_{IMP}$** |
|---|---|
| Data unit: | MWh |
| Description: | Total amount of electricity imported to meet project requirements |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | EM01 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 23.392 MWh (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | EM01. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | **H** |
|---|---|
| Data unit: | h |
| Description: | Working plant hours |
| Measured /Calculated /Default: | Directly measured |
| Source of data: | HC01 (see Annex 1: monitoring equipment location) |
| Value(s) of monitored parameter: | 8,760 h (total value in the monitoring period) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline/Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | HC01. For detailed informations see Table 3 in the Section C.1.1. |
| Measuring/ Reading/ Recording frequency: | Continuously, h |
| Calculation method (if applicable): | |
| QA/QC procedures applied: | See “QCCDFBERP Monitoring plan” in Annex 2 |

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

The formula used for the Baseline emissions calculation is reported below (the spreadsheets **ER calculation sheet_ *20XX month***.):

$$BE_y = (LFG_{flared,n} \times w_{CH4,y} \times \rho_{CH4} \times GWP_{CH4}) - (\varepsilon_{MD\ flared\ before\ PE} \times GWP_{CH4}) + (LFG_{electricity,n} \times w_{CH4,y} \times \rho_{CH4} \times GWP_{CH4}) - (\varepsilon_{MD\ electricity} \times GWP_{CH4})$$

For the meaning of all the terms see the sections D.1., D.2. and E.4.1.

### E.2. Project emissions calculation

The formula used for the Baseline emissions calculation is reported below (the spreadsheets **ER calculation sheet_ *20XX month***.):

$$PE_y = BE_y - ER_y$$

### E.3. Leakage calculation

No leakage calculation is required.

### E.4. Emission reductions calculation / table

#### E.4.1. Table providing the formulas used

| Variable | Description | Unit of measure | Equation used |
|---|---|---|---|
| $PE_{flare}$ | Project emissions | t $CO_{2eq}$ | $PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \cdot (1-\eta_{flare,h}) \cdot \frac{GWP_{CH4}}{1000}$ |
| $MM_{RG,h}$ | Molecular mass of the residual gas | kg/kmol | $MM_{RG,h} = \sum_{i} (fv_{i,h} * MM_i)$ ($fv_{i,h}$= $fv_{CH4,h}$) |
| $\rho_{RG,h}$ | Density of the residual gas | kg/$m^3$ | $\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$ |
| $FM_{RG,h}$ | Mass flow rate of the residual gas | kg/h | $FM_{RG,h} = \rho_{RG,n,h} \times FV_{RG,h}$ |
| $TV_{n,FG,h}$ | Volumetric flow rate of he exhaust gas | $m^3$/h | $TV_{n,FG,h} = V_{n,FG,h} \times FM_{RG,h}$ |
| $TM_{FG,h}$ | Mass flow rate of methane in the exhaust gases | kg/h | $TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH4,FG,h}}{1000000}$ |

| | | | |
|---|---|---|---|
| $TM_{RG,h}$ | Mass flow rate of methane in the residual gas | kg/h | $TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$ |
| $\eta_{flare}$ | Flare efficiency | | $\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}}$ |
| $MD_{electricity}$ | Methane destroyed by generation of electricity | t $CH_4$ | $MD_{electricity,y} = LFG_{electricity,y} \cdot w_{CH4} \cdot D_{CH4}$ |
| $MD_{flared}$ | Methane flared | t $CH_4$ | $MD_{flared,y} = \{LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$ |
| $MD_{project}$ | Methane flared/combusted | t $CH_4$ | $MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y}$ |
| $EL_y$ | Net exported electricity | MWh | $EL_y = EL_{EX,LGFG} - EL_{IMP}$ |
| $ER_y$ | Emission reductions | t $CO_{2eq}$ | $ER_y = MD_{project,y} * GWP_{CH4} + EL_y * CEF_{electricity,y}$ |

*Table 4*

The $\varepsilon$ equivalent error calculation is applied the following variable:

$$\varepsilon_{PE\ flared} = \sqrt{(err_{PT04})^2 + (err_{TT02})^2 + (err_{FT04\_a})^2 + (err_{GA02_{ch4}})^2 + (err_{GA02_{02}})^2}$$

$$\varepsilon_{MD\ flare\ d\ before\ PE\ reduction,\ y} = \sqrt{(err_{PT04})^2 + (err_{TT02})^2 + (err_{FT04\_a})^2 + (err_{GA01})^2}$$

*(error related the product* $LFG_{flare,y} * w_{CH4} * D_{CH4}$ *)*

$$\varepsilon_{MD_{electrucity}} = \sqrt{(err_{PT04})^2 + (err_{TT02})^2 + (err_{FT05\_a})^2 + (err_{GA01})^2}$$

$$\varepsilon_{EL} = \sqrt{(err_{EM01})^2}$$

Where the $err_{aabb}$ is the sum of error plus uncertain associated to the instrument involved in the variable calculation (see Table 3)

The variable correction after equivalent error calculation is :

$$XX_{corr} = XX_y * (1 - \varepsilon_{xx})$$

**E.4.2. Description and consideration of measurement uncertainties and error propagation**

The data parameters are measured rounded to four decimals.
In the baseline calculation the numbers were rounded down after four decimals and in calculation of the project emissions the numbers were rounded up after four decimals. Then, the final emissions reductions were rounded down to the unit.

**E.4.3. GHG emission reductions calculation**

The data are available in the **ER calculation sheet_ *20XX month*** and provided to DOE.

For $PE_{flare}$ calculation details and equivalent error calculation and correction see also **ER calculation sheet_ *20XX month***.

The Table 5 and Table 6 shows the Baseline Emissions, the Project Emissions and the Emission Reductions during the monitoring period.

| Period | ***BE*** **[t $CO_{2\ eq}$]** | ***PE*** **[t $CO_{2\ eq}$]** | ***LE*** **[t $CO_{2\ eq}$]** |
|---|---|---|---|
| 1st April – 30 April 2010 | 9,609.5 | 3.3 | 0.0 |
| 1st May – 31 May 2010 | 9,954.1 | 10.1 | 0.0 |
| 1st June – 30 June 2010 | 8,791.7 | 3.9 | 0.0 |
| 1st July – 31 July 2010 | 10,923.6 | 0.7 | 0.0 |
| 1st August – 31 August 2010 | 10,631.6 | 0.7 | 0.0 |
| 1st September – 30 September 2010 | 10,083.9 | 2.9 | 0.0 |
| **TOTAL** | **59,994** | **22** | **0** |

*Table 5*

| Period | **[t $CO_{2\ eq}$]** |
|---|---|
| 1st April – 30 April 2010 | **9,606.2** |
| 1st May – 31 May 2010 | **9,944.0** |
| 1st June – 30 June 2010 | **8,787.8** |
| 1st July – 31 July 2010 | **10,922.9** |
| 1st August – 31 August 2010 | **10,630.9** |
| 1st September – 30 September 2010 | **10,081.0** |
| **TOTAL ER REQUESTED** | **59,972** |

*Table 6*

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

A comparison of actual values of the emission reductions achieved during the current monitoring period with the estimations in the registered CDM-PDD is reported in the table below.

| Item | Values applied in ex-ante calculation of the registered CDM-PDD | Actual values reached during the monitoring period |
|---|---|---|
| **Emission reductions ($tCO_2e$)** | **65,513*** | **59,972** |

*Since the value applied in ex-ante calculation of the registered CDM-PDD is an yearly value (131,027 for the year 2010), an average monthly value multiplied by the number of months of the current monitoring period (6 months for the 5th Verification) is considered

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

There isn't any increase in the actual emission reductions achieved during the current monitoring period compared to that stated in the registered CDM-PDD.

The garbage disposal activity of the Disposal Facility Management Office (POG), requests periodically the partial disconnection of some wells located in the two Mound area ; this situation has caused and causes a loss in biogas production in the areas occupied by dumping activity (is this also the reason for significant less CERs compared to PDD); the lost production is partially recovered through the installation of new wells in elevation, and horizontal trenches. This situation, despite the increasing of wells number, affected negatively the target achieving fixed in the PDD. However from the plant start up, is demonstrable an increasing of the biogas production trend.