**MONITORING REPORT FORM (CDM-MR)**
**Version 01 - in effect as of: 28/04/2010**

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**MONITORING REPORT**
**Version number 00 of 14/12/2011**

**Quezon City Controlled Disposal Facility Biogas Emission Reduction Project (QCCDFBERP)**
**CDM Registration Reference number 1258**
**7th Monitoring Period: 01/04/2011 – 30/09/2011**

## 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 7,500 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 2011 to the 30th September 2011), the total amount of emission reduction requested is equal to 60,475 CERs.

## A.2. Project Participants

| | |
|---|---|
| Organization: | Quezon City |
| Street/P.O.Box: | Elliptical Road |
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| City: | Quezon City – Metro Manila |
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| | |
|---|---|
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| | |
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| Salutation: | |
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| Middle Name: | |
| First Name: | Francois |
| Department: | |
| Mobile: | |
| Direct FAX: | |
| Direct tel: | |
| Personal E-Mail: | |

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

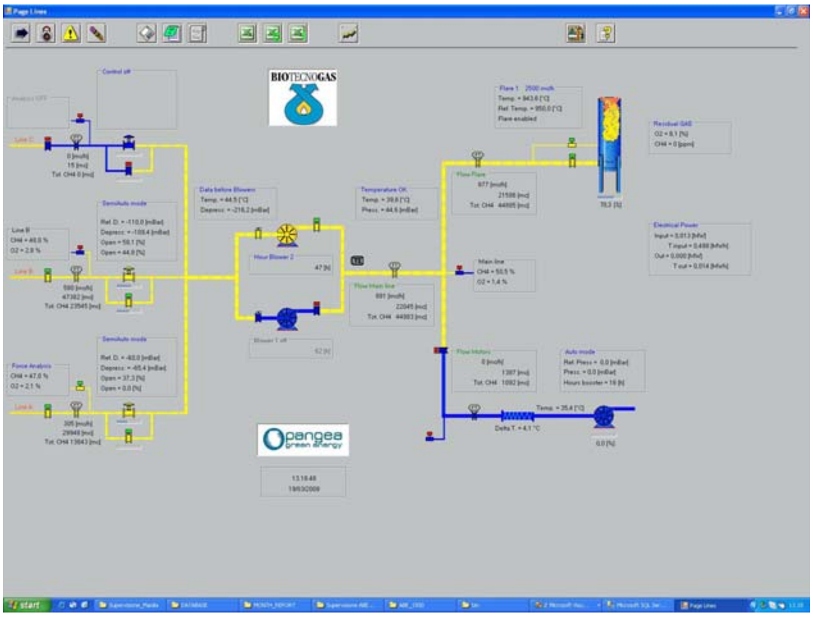
Area 2, Barangay Payatas, Quezon City, Metro Manila, Philippines.
GPS coordinates: Latitude: 14.715469° Longitude: 121.104114°


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

## A.4. Technical description of the project

From the first April 2011 until to the end of September 2011 the network has included 87 wells-trenches 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: SCADA*

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 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 200 kW (250 kVA- power factor 0.8) |

| Equipment | Manufacturer | Type | Technical data |
|---|---|---|---|
| | | | • 1,500 rpm<br>• 400/230 V 50 Hz<br>• 3 phases |

*Table 1*

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*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 Philippines Inc*
*Zamboanga St., Group 3, Area B*
*Brgy. Payatas, Quezon City 1119 Philippines*

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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 |
| 3rd 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) | 71 | 14 | **85** | 4 |
| 6th monitoring period (1st October 2010– 31 March 2011) | 71 | 16 | **87** | 4 |
| 7th monitoring period (1st April 2011– 30 September 2011) | 71 | 16 | **87** | 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 (this is 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 2012; 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 2010-2011, because the delay connected to the CERs issuance caused problems to start this development. During the period of 7th verification was set the financial due diligence end defined the plant final design.

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 7 meters in just 42 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.

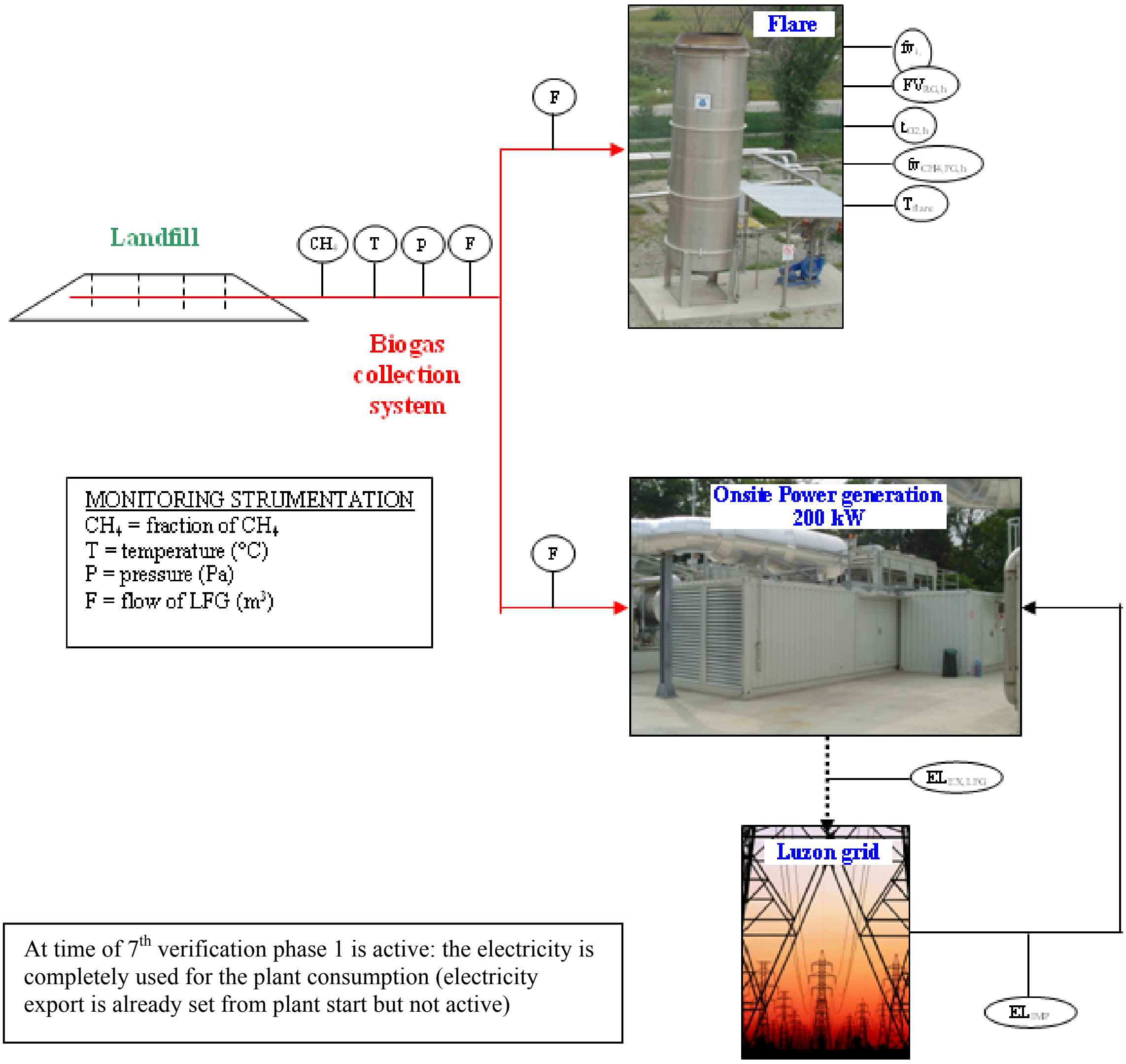
### B.4. Notification or request of approval of changes

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% / 0.025% | 130-2,500 $m^3/h$ | 2 years | 24/2/2011 | PREMIER Physic Metrologie | 01/04/2011-30/09/2011 |
| FT04_a | Flow Meter | EMERSON - ROSEMOUNT | 485 - 0075924<br>3051S1CD1A2E12A1AB4D2E1L4Q4 -8696152 | Flare pipeline | 0% / 0.025% | 130-2,500 $m^3/h$ | 2 years | 24/2/2011 | PREMIER Physic Metrologie | 01/04/2011-30/09/2011 |
| FT05_a | Flow Meter | EMERSON - ROSEMOUNT | 485 - 0075925<br>3051S1CD1A2E12A1AB4D2E1L4Q4 -8696154 | Engine pipeline | 0.032% / 0.025% | 13-250 $m^3/h$ | 2 years | 24/2/2011 | PREMIER Physic Metrologie | 01/04/2011-30/09/2011 |
| GA01 | Methane content analyzer | SIEMENS | ULTRAMAT 23 – N1-V7-0538 | Main pipeline | 1% $CH_4$<br>0.5% $O_2$ | 0-100% $CH_4$<br>0-25% $O_2$ | 1 year | 18/01/2011 | PANGEA AIR LIQ. | 01/04/2011-30/09/2011 |
| 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 | 10/8/2009 | PREMIER Physic Metrologie | 01/04/2011-07/07/2011 |
| | | | | | 0.18% / 0.14% | | | 08/07/2011 | | 08/07/2011-30/09/2011 |
| PT04 | Pressure meter | ABB | 264HS-6407024078 | Main pipeline | 0.39% | 0-250 mbar | 2 years | 10/08/2009 | PREMIER Physic Metrologie | 01/04/2011-07/07/2011 |
| | | | | | 0.30% | | | 08/07/2011 | | 08/07/2011-30/09/2011 |
| TT03 | Temperature meter flare bottom | ELSI | Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 11-10/63288 | Flare bottom | 0.042% / 0.21% | 0-1,600 °C | 2 years | 01/10/2010 | Elsi Calibration Center | 01/04/2011-30/09/2011 |

| ID | Type | Manufacturer | Model - Serial Number | Location | Error / Uncertainty | Range | Calibration frequency | Last calibration | Calibration Entity | Oper. period |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 12/7/2010 | PREMIER Physic Metrologie | 01/04/2011-07/07/2011 |
| | | | | | 0.06% / 0.30% | | | 08/07/2011 | | 08/07/2011-30/09/2011 |
| GA02 | Exhaust gas analyzer | SIEMENS | ULTRAMAT23 - N1-V0-0038 | Flare | 1% $CH_4$<br>0.5 % $O_2$ | 0-100% $CH_4$<br>0-25% $O_2$ | 1 year | 18/01/2011 | PANGEA AIR LIQ. | 01/04/2011-30/09/2011 |
| EM01 | Energy meter | GENIUS | EDMI N680 - 209074056 | Main electrical panel | 0.166% | 5(20) A – 240V | 2 years | 26/05/2010 | ERC Philippines | 01/04/2011-30/09/2011 |
| FT01 | Flow meter line "A"" | EMERSON - ROSEMOUNT | 285G050ZCSP1S17 -0053154 | Line "A | 0.1% | 0-1,200 $m^3/h$ | 2 years | 10/08/2009 | PREMIER Physic Metrologie | 01/04/2011-07/07/2011 |
| | | ABB | 264DS - 6407021990 | | 0.1% | | | 08/07/2011 | | 08/07/2011-30/09/2011 |
| FT02 | Flow meter line "B" | EMERSON - ROSEMOUNT. | 285G050ZCSP1S17 -0050959 | Line "B" | 0.1% | 0-1,200 $m^3/h$ | 2 years | 10/08/2009 | PREMIER Physic Metrologie | 01/04/2011-07/07/2011 |
| | | ABB | 264DS - 6407021989 | | 0.1% | | | 08/07/2011 | | 08/07/2011-30/09/2011 |
| HC01 | Plant hours counter | BIOTECNOGAS | SCADA | Plant PC | --------- | 0-999999 h | Not required | --------- | --------- | 01/04/2011-30/09/2011 |

*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** |
|---|

**C.2.1 Documented procedures and management plan:**

The Payatas Plant quality management system is based on ISO 9001:2000 standard. The management system considers the conformity of Pangea Quality System to the standard as an important target necessary to achieve future system certifications.

The policy of Pangea Green Energy Philippines Inc. is to accomplish company mission and achieve targets with the continuous application of quality system procedures.

The system includes the following:

- Documentation of plant operation and maintenance procedures;
- Systematic and consistent data monitoring and analysis;
- Control of documents and records;
- Control of nonconforming output;
- Corrective and preventive actions;
- Internal audits;
- Training and information activities; and
- Emergency management.

*C.2.1.1 Roles and responsibilities:*

Pangea Green Energy Philippines Inc. (hereinafter Pangea Phils.) is responsible for the project site operation and maintenance. Regarding local permits and authorizations as well as any CDM related procedures and requirements, Pangea Phils. provides technical support for the proper management, operation and maintenance of the plant.

For best plant performance, Pangea Phils. structured the plant operation management organization and defined the roles and responsibilities as attached:

The plant operation management includes the following activities:

- Biogas extraction system setting;
- Biogas wells and pipeline network maintenance;
- Plant operation management;
- Plant data management;
- Plant maintenance;
- Biogas extraction system expansion.

All the plant activities especially operation and maintenance are defined in the PGBIO001 Operation including all scheduled and unscheduled service and maintenance activities. Activities that cannot be performed by existing human resources and facilities shall be ordered separately from qualified supplier selected under the internal purchase procedure POPRC001.

*C.1.1.2 Trainings*

Training is one of the most important activities that permits optimum operation of the plant. Pangea ensures that its workers are properly and sufficiently trained to operate and maintain the plant, and constantly updated on relevant information on biogas or landfill gas management, control, recovery and utilization as well as Clean Development Mechanism procedures.

All the Pangea's Staff received complete orientation and training regarding:

- Plant operation and maintenance;
- Plant quality management system;
- Specific tasks and activities, and their relevance to achieving the general objectives;
- Health and safety rules; and
- Environment specification.

Procedures described in POTR001 specify the orientation and training activities based on the following:

- Continuous improvement of capability and skills of personnel;
- Annual assessment and evaluation of personnel skills, and necessary additional training;
- Scheduling of all periodical training with final evaluation;
- Registration of all training season.

During the plant commissioning, Biotecnogas, the supplier of the biogas extraction and burning plant, trained Pangea's engineers to manage and control the biogas extraction and flaring equipment.
All the trainings regarding plant management, operation, control and maintenance were organized by Pangea. The trainings were carried out according to the specifications and manuals of each equipment.
The training for the setting of biogas extraction system was carried out by Pangea specifically the adjusting of gas wells and substations as well as draining of condensate traps and knockout pots.
On the plant supervision and management system, the training was carried out by AB Energy, subcontracted by Biotecnogas for the commissioning. AB Energy taught to the Pangea staff how to use and calibrate the landfill gas analyzer; showed the location of the different plant instruments, and explained how each instrument works and what they measure; how the data are logged and are recorded in the computer using the SCADA; and how to manage and adjust the setting of the plant through the SCADA.

Pangea inspects and assesses the performance of the plant, evaluates the staff and provides feedback, and implements modifications if necessary. Any modification to the existing plant shall be done according to the specifications and will be made known and explained to the Pangea site engineers.

### C.2.2 Involvement of Third Parties:

In order to accurately determine the amount of exhaust gas produced by the plant, we need to know the actual atmospheric pressure in the area. This can be approximated using the mean sea level pressure data. Pangea requested from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

The Quezon City Controlled Disposal Facility is being managed by the Payatas Operations Group (POG), a unit specially created by the Quezon City government to oversee the dumpsite operations. Rehabilitation of the dumpsite, which includes slope reprofiling, soil capping, construction of drainage system for surface runoff and leachate and vegetation cover, is being handled by Quezon City's contractor, the IPM Group of Companies (IPM). Pangea coordinates closely with both the POG and IPM all its activities that will affect the ongoing rehabilitation activities at the dumpsite such as

construction of additional wells. The positive environmental impacts of the project are communicated to the Payatas residents through the POG. Pangea also conducts lectures regarding the scope, objectives, impacts and status of the project to interested parties from other parts of the country and even abroad.

### C.2.3 Internal audits and control measures

Pangea's management system includes an audit management procedure. The procedure PGSYS002 establishes an annual audit of the main plant procedures and activities. The status of the plant including all technical details are monthly controlled based on the daily operation journals provided by Pangea. There is also a POBIO001 procedure being implemented in order to periodically check all plant equipments and accessories.

All collected data are reviewed periodically during the scheduled controlling meetings, according to its internal quality management policy. Based on the monthly reporting, modifications to the periodic maintenance steps may be implemented if necessary.

On a yearly basis, at the same time the periodic verification of emission reductions, technical control and service activities are repeated by Pangea.

### C.2.4 Troubleshooting procedures

The plant management system includes procedure for the operation and maintenance of the plant described in POBIO001, and for emergency situation management described in procedure POEM001.

In case of any failure or malfunction, the plant will set off an automatic alarm. The security personnel were instructed to call the plant engineer in such a situation so that he can immediately inspect the plant and identify the cause of failure or malfunction. The event and the results of the investigation are noted in the daily journal and in the emergency visit report. (Emergency visit reports can be provided on request.)

In case of unclear situation, the engineer contacts the suppliers for consultation and technical service support. In case of external technical problems, the concerned or appropriate service suppliers might be involved to solve the problem.

**In case of any failure or malfunction to any measuring device the following troubleshooting procedures will be carried out to meet the requirements of the monitoring methodology:**

**Power supply failure**

In case of short power outages when the complete landfill gas collection system including the blower engine and flare are out of operation as no emergency power supply is installed, all measuring devices are also out of operation. Recorded data are secured by emergency batteries to protect internal memory for approx. 12 hours of power outage or data are fixed based on an analogue measuring device.

**Failure of gas flow meter**

Gas flowmeters and/or any related equipment or device that failed or are not functioning properly shall be repaired as soon as possible. The existing plant lay-out includes three (3) different flowmeters – main line, flare line, and engine line. In case of failure of any one of the three flowmeters, the data logger can detect the gas flow based on the sum or difference of the other two installed gas flowmeters.

The flare line flowmeter is of the same type as the main line flow meter hence can provide the flow rate in $m^3/h$; as such it is also possible to use one in case there is a problem with the other. If both the flare line and main line flowmeters fail, it is also possible to use the flow meter installed in Line A and B. .

**Failure of gas analyzer instruments**
Gas analyzers and/or any related equipment or device that failed or are not functioning properly shall be repaired as soon as possible. While the gas analyzer is out of service, the portable gas analyzer shall be used to monitor the biogas composition.

**Failure of temperature sensor**
Temperature sensors and/or any related equipment or devices that are not functioning properly will be repaired as soon as possible. Spare parts are readily available in the plant. But in the unlikely event that the item to be replaced is not readily available, a new temperature sensor will be installed.

**Failure of energy meter**
In case of malfunction of the energy meter, repair or replacement of defective part shall be done as soon as possible. During the period when the energy meter is not in operation, the energy consumption of the project can be determined using the energy meter installed by MERALCO and can be provided upon request. Likewise, it is possible to check the total consumption of energy from the Meralco billing statement.

**Failure of portable gas analyzer**
In the unlikely event of malfunction of the portable gas analyser, repair or replacement of defective part shall be done as soon as possible. In case of failure of the oxygen analyser, the plant will be shut down because of safety reasons. In case of failure of the carbon dioxide analyzer, immediate troubleshooting is not required as this parameter is not necessary for emission reduction calculation. In case of failure of the methane analyzer, the carbon dioxide and oxygen measurements can be used to estimate the amount of methane.

**Failure of data-logger**
In the unlikely event of malfunction of the Datalogger and/or any related equipment, repair or replacement of defective part will be done as soon as possible. In case of failure of the data logger, the following measuring devices can work independently and can be recorded manually:

- gas flowmeters;
- energy meter;
- hour counter;
- gas analyzers.

Aside from these independent measurements, landfill gas quality particularly the methane concentration shall be recorded manually according to the troubleshooting procedure for failure of landfill gas analyser. In addition to this manual recording, one gas sample will be taken every week if the data-logger is not in operation. The results can be taken as an average value for the gas quality during the period the data-logger is not in operation. In this case, calibration reports of the portable landfill gas analyzer will be included in the monitoring report.

## 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: | 10,697,306 $m^3$ (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 information, 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: | 10,260,833 $m^3$ (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 information, 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: | 323,944 $m^3$ (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 information, 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 on LFG, T, P parameters measured |
| Value(s) of monitored parameter: | 1,963 $Nm^3/h$ (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) | FT04_a, TT02, PT04. For detailed information, 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<br>$P_n$ = 1,013.25 mbar |

| | |
|---|---|
| QA/QC procedures applied: | See "QCCDFBERP Monitoring plan" in Annex 2 |

| **Data / Parameter:** | $\mathbf{f_{vCH4,h}}$ |
|---|---|
| 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: | 45.825% (average value in the monitored 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 information, 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:** | $\mathbf{t_{O2,h}}$ |
|---|---|
| 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: | 13.862% (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 information, 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:** | $\mathbf{f_{vCH4,FG,h}}$ |
|---|---|

| | |
|---|---|
| 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: | 1.732 $mg/m^3$ (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 information, 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: | 675.513 °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 information 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: | 68.952 °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 information, 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: | 49.512 mbar = 4,951.2 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 information, 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 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 information, 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: | 15.882 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 information, 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: | 4,392 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 information, 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 | $MM_{RG,h} = \sum_{i} (fv_{i,h} * MM_i)$ <br> ($fv_{i,h} = fv_{CH4,h}$) |
| $\rho_{RG,h}$ | 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 the 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:

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

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

*(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 show the Baseline Emissions, the Project Emissions and the Emission Reductions during the monitoring period.

| **Period** | ***BE*** **[t $CO_{2\ eq}$]** | ***PE*** **[t $CO_{2\ eq}$]** |
|---|---|---|
| 1st April – 30 April 2011 | 10,618.7 | 0.2 |
| 1st May – 31 May 2011 | 10,582.8 | 0.5 |
| 1st June – 30 June 2011 | 9,952.7 | 2.1 |
| 1st July – 31 July 2011 | 9,704.4 | 6.7 |
| 1st August – 31 August 2011 | 10,212.9 | 0.9 |
| 1st September – 30 September 2011 | 9,416.5 | 2.6 |
| **TOTAL** | **60,488** | **13** |

*Table 5*

| Period | [t $CO_{2\,eq}$] |
|---|---|
| 1st April – 30 April 2011 | **10,618.5** |
| 1st May – 31 May 2011 | **10,582.3** |
| 1st June – 30 June 2011 | **9,950.6** |
| 1st July – 31 July 2011 | **9,697.7** |
| 1st August – 31 August 2011 | **10,212.0** |
| 1st September – 30 September 2011 | **9,413.9** |
| **TOTAL ER REQUESTED** | **60,475** |

*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 ($tCO_2e$)** | **60,678*** | **60,475** |

*Since the values applied in ex-ante calculation of the registered CDM-PDD are yearly values (121,355 for the year 2011), the ex-ante value of ERs is calculated as follows: 121,355 × (6 / 12) (for April, May, June, July, August, and September 2011), that is equal to 60,678

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

There is no 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.