Quezon City Controlled Disposal Facility Biogas Emission Reduction Project

(QCCDFBERP)

CDM Registration Reference number 1258

Geographical coordinates: 14° 42’ 55,69” N 121° 06’ 14,81 E

MONITORING REPORT

(Monitoring period: July 1st 2009, to December , 31th - 2009)

3rd verification

9 February 2010 **rev. 1**

Contents:

Background

The monitoring report has been drafted according to the Monitoring plan procedures as reported in Section B.7 of the PDD. The Monitoring plan in the PDD was implemented by the project participants in the ”QCCDFBERP Monitoring plan”; referred to this monitoring report that defines all the monitoring procedures implemented at the project activity site.

SECTION A: general project activity and monitoring information

A.1 Title of the project activity:

Quezon City Controlled Disposal Facility Biogas Emission Reduction Project (QCCDFBERP)

A.2. CDM registration number:

CDM Registration Reference number 1258; registered in February 1st, 2008,

A.3. Short description of the project activity:

A.3.1. Real Project Implementation

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 8000 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 third year.

Picture 1 : flare and biogas plant

The plant was completed and commissioned in March 2008.

At the time 31 December 2009 the network included 80 wells-trenches divided into two areas of the dumpsite, the Old and New Mound, on a surface of about 10 ha. Wells are around 15-21 meters deep and are approximately 45 meters from each other to achieve optimum efficiency of biogas extraction process.

Picture 2 : substation and pipes from wells

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.
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 equipments' characteristics are described in table 1.

The capacity of the electricity generator presently installed is 200 kW. 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 • 15-25 m deep • Equipped with well head and regulation valve
		Pipeline	• HDPE material, • 90 diameter
		Substation	• 5m x 2.5 - 2 arms • Iron anti corrosion painted, • Butterfly valve equipped
		Main pipeline	• HDPE material, • 90 diameter-160 mm
Biogas blower	Continental Industrie	051A.03	• Flow: 2500 Nm^3/h • Discharge pressure: 80 mbar • Discharge temp: 56.4 degrees C • Electric engine supplied also by Continental Industrie, 37 kW
High temperature enclosed gas flare	Biotecnogas	BTG2500HT	• Capacity 500 - 2500 Nm^3/h, • External diam: 2,200 mm, • Height 9.50 mm,

Equipment	Manufacturer	Type	Technical data
			• Thickness 150 mm, • Material: stainless steel AISI 304; • Feeding pressure: 50 mbar • Min CH_4 %: 30% • Ratio CH_4/CO_2>1 • Combustion chamber: refractory made of ceramic fiber modules, thickness 150 mm • Combustion temperature: > 850 C° • Retention time >= 0.3 sec • Critical temperature: 1,430 C° • Combustion coeff. (CO_2/ CO + CO_2): min 99%
Booster	Mapro	CL 18/01 G	• Nominal flow rate: 150 Nm3/h ca; Pressure in: 50 mbar; Pressure out: 150 mbar • Power: 3.6 kW ca
Engine	Iveco -ATME	Iveco Aifo 8281	• 8 cylinder turbo engine • Biogas feeding set • capacity 250 kVA • 1500 rpm • 400/230 V 50 Hz • 3 phases -

Tab 1

The improvements starting from the plant activities have been directed, concerning the biogas collection system, to build new wells, horizontal trenches and substation (see table 2); for the plant 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 (see A.6 paragraph) .

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 caused and causes a loss in biogas production in the areas occupied by dumping activity; 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 trend biogas production.

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

Tab 2

Picture 3 : plant picture from old moud

A.3.2. Changes against the PDD

No major changes were made.

A.4. Monitoring period:

From July 1st, 2009, to December 31th, 2009.

A.5. Methodology applied to the project activity (incl. version number):

A.5.1. Baseline methodology:

ACM0001 ver. 5 - Consolidated methodology for landfill gas project activities.

A.5.2. Monitoring methodology:

ACM0001 ver. 5 - Consolidated methodology for landfill gas project activities.

A.6. Intended deviations or revisions to the registered "QCCDFBERP Monitoring plan"

The project activity has deviated from the registered PDD since:

- From the plant start operation just to 9th November 2008 the "Temperature in the exhaust gas of the flare" (as defined in the "Tool to determine project emissions from flaring gases containing methane") has been measured with a Tflare probe (TT03) installed 1.80 meters above the burner .This deviation from the Methodological Tool has been investigated by the DOE and it's confirmed that it would have been addressed and resolved installing a second Tflare probe at the correct height of the flare (same level of the oxygen and methane fraction probes) to allow to fully comply with the methodology. According to this, no amendment of the Methodology was required. The deviation was accepted on EB n. 45 11-13 February 2009.

On 8th November, 2008, an additional Tflare probe (TT04) has been installed at the same level of the oxygen and methane fraction probes correcting the deviation. For the period 1st September 2008- 9th November 2008 (2nd verification) a same deviation, accepted on EB n. 45 11-13 February 2009, has been requested.

- The $LFGtotal_{,y}$ parameter has been measured using two additional Annubar-type meters on lines A and B instead of a turbine meter on the main line, as defined in the registered PDD. This change in the $LFGtotal_{,y}$ measurement approach has been applied by the project participants due to the breakdown of the main turbine meter. The redundancy of the measurement equipments which was in place has allowed Pangea to use the two Annubar meters to estimate the $LFGtotal_{,y}$ and to compare it with the sum of the flow data LFGflare and LFGelectricity.. The results obtained confirm that this approach, due to the accuracy of the Annubar meters, have allowed to perform the required verification (LFGtotal,y = LFGflare + LFGelectricity) in a reliable way. The deviation was accepted on EB n. 45 11-13 February 2009.

  On 27th March 2009 a new flow meter FT03_a has been installed instead of broken turbine meter to measure $LFGtotal_{,y}$ correcting the deviation. For the period 1st September 2008- 27th March 2009 (2nd verification) a same deviation, accepted on EB n. 45 11-13 February 2009, as been requested.

A.7. Changes since last verification:

This is the third periodic verification.

A.8. Person(s) responsible for the preparation and submission of the monitoring report:

This monitoring report was developed and reviewed by:

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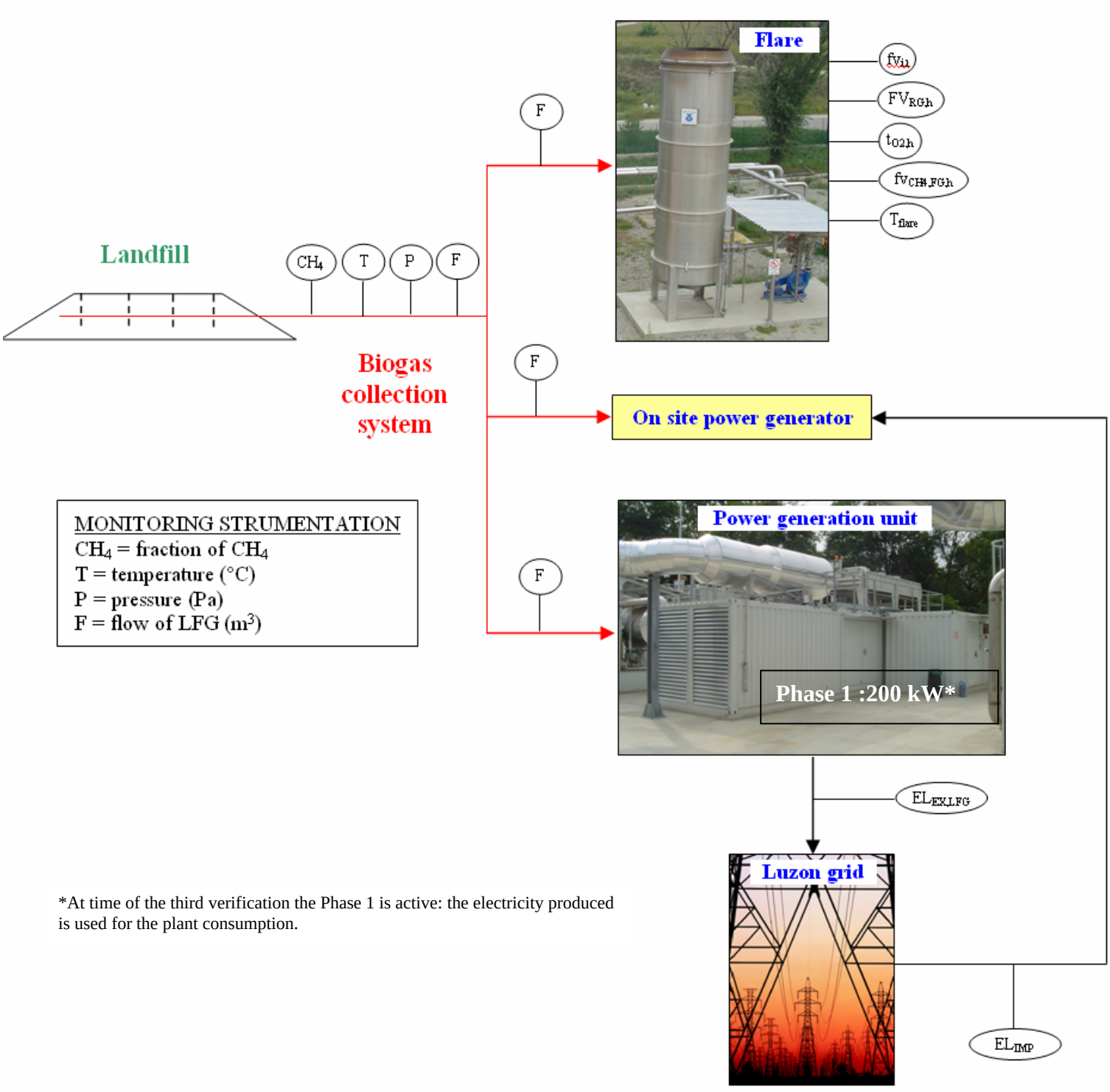
SECTION B. Key monitoring activities according to the "QCCDFBERP Monitoring plan" for the monitoring period stated in A.4. (referring to Decision 17/CP.7, Annex H, paragraph 53 (a) – (d) on data collection and archiving)

B.1. Monitoring equipment:

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



*At time of the third verification the Phase 1 is active: the electricity produced is used for the plant consumption.

B.1.2. 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
FT03_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075923 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696153	Main pipeline	0.0087/0.025%	130-2500 m^3/h	2 years	28/2/2009	EMERSON – PROCESS MANAGEMENT
FT04_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075924 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696152	FLARE pipeline	0.001/0.025%	130-2500 m^3/h	2 years	28/2/2009	EMERSON – PROCESS MANAGEMENT
FT05_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075925 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696154	Engine pipeline	0.001/0.025%	13-250 m^3/h	2 years	29/4/2009	EMERSON – PROCESS MANAGEMENT
GA01	Methane content analyser	SIEMENS	ULTRAMAT 23 – N1-V7-0538	Main pipeline	1% CH_4 0.5 % O_2	0-100% CH_4 0-25% O_2	Annual	19/3/2009	PANGEA AIR LIQ.
TT02	Temperature meter	ELSI Srl	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 Phisic metrologie
PT04	Pressure meter	ABB	264HS-6407024078	Main pipeline	0.49%	0-250 mbar	2 years	10/08/2009	PREMIER Phisic metrologie
TT03	Temperature meter	ELSI	Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 12-08/3358	Flare bottom	0.102% / 0.19%	0-1600 C°	2 years	04/12/2008	Elsi Calibration center
TT05	Temperature meter	ELSI	Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 10-07/748	Flare Top	0.19% / 0.19%	0-1600 C°	2 years	10/8/2009	Elsi Calibration center
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	Annual	19/3/2009	PANGEA AIR LIQ.

ID	Type	Manufacturer	Model -Serial Number	Location	Error / Uncertainty	Range	Calibration frequency	Last calibration	Calibration Entity
EM01	Electricity meter	GENIUS	EDMI N680 - 206584765	Main Electrical Panel	0.148%	5(20) A – 240V	2 years	10/3/2009	ERC Philippines
FT01	Flow meter line “A””	EMERSON - ROSEMOUNT	285G050ZCSP1S17 - 0053154	Line “A	0.01%	0-1200 m^3/h	2 years	10/8/2009	PREMIER Phisic metrologie
		ABB	264DS - 6407021990						
FT02	Flow meter line “B”	EMERSON - ROSEMOUNT.	285G050ZCSP1S17 - 0050959	Line “B”	0.01%	0-1200 m^3/h	2 years	10/8/2009	PREMIER Phisic metrologie
		ABB	264DS - 6407021989						
HC01	Engine hours counter	GRASSLIN	TAXXO 102 UWZ48E	Engine	---------	0-999999 h	Not requested	----------	Grasslin
HC02	Plant hours counter	BIOTECNOGAS	SCADA	Plant pc	---------	0-999999 h	Not requested	----------	----------

Tab. 3

The flow meters FT01 and FT02 are backup flow meters. The periodicity of calibration of all monitoring equipment were based on manufacturer recommendation (as there is no law or regulation in this regard). 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 “Monitoring plan”.

B.1.3. Calibration procedures:
See table 1

B.2. Data collection (accumulated data for the whole monitoring period):

B.2.1. List of fixed default values:

Parameter	Description	Value	Unit of measure	Source
GWP_{CH4}	Global Potential Warming of methane	21	t CO_{2eq}	Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996)
D_{CH4}	Methane density	0,0007168	t/m^3	Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996)
$CEF_{electricity,y}$	CO_2 emissions intensity of the electricity displaced	0,46	t CO_2/MWh	Calculated according to AMSI.D Version 10 (see PDD)

Table 4

B.2.2. List of variables

Parameter	Description	Unit of measure	Source	Frequency
$LFG_{Total,y}$	Amount of landfill gas flared	m^3	Directly measured	Continuously , h
$LFG_{flare,y}$	Amount of landfill gas flared	m^3	Directly measured	Continuously , h
$LFG_{electricity,y}$	Amount of landfill gas combusted in power plant	m^3	Directly measured	Continuously , h
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*	m^3/h	Calculated (based of LFG, T, P parameters measured)	Continuously , h
$f_{vCH4,h}$	Volumetric fraction of methane in the	%	Directly measured	Continuously , h

Parameter	Description	Unit of measure	Source	Frequency
	residual gas in the hour *h*			
$t_{O2,h}$	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h	%	Directly measured	Continuously , h
$f_{vCH4,FG,h}$	Concentration of methane in the exhaust gas of the flare in dry basis at normal condition in the hour *h*	mg/m^3	Directly measured	Continuously , h
T_{flare}	Temperature in the exhaust gas of the flare	°C	Directly measured	Continuously , h
T	Temperature of the landfill gas	°C	Directly measured	Continuously , h
P	Pressure of the landfill gas	mbar	Directly measured	Continuously , h
$EL_{EX,LFG}$	Total amount of electricity exported out of the project boundary	MWh	Directly measured	Continuously , h
EL_{IMP}	Total amount of electricity imported to meet project requirements	MWh	Directly measured	Continuously , h
H	Working plant hours	h	Directly measured	Continuously , h

Table 5

B.2.3. Data concerning GHG emissions of the baseline (referring to paragraph 53(b)) and of the project activity (referring to paragraph 53(a)):

The data are available in the **ER calculation sheet_ *mont_200X*** and provided to DOE

B.2.4. Data concerning leakage (referring to paragraph 53(c)):

According to ACM0001 Version 05 no leakage needs to be considered.

B.2.6. Data concerning environmental impacts (referring to paragraph 53(d)):

Since the beginning of plant operation, gas odor on top of the mounds was greatly reduced. The subsidence of the garbage mounds was up to 3 meters in just 24 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 also permits a new dumping activity in the two mounds. Continuous extraction of gas from the dump 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 will develop in 2010 a food program in cooperation with NGO for Payatas children.

SECTION C. Quality assurance and quality control measures

See “QCCDFBERP Monitoring plan”

SECTION D. Calculation of GHG emission reductions (referring to Decision 17/CP.7, Annex H, paragraph 53 (f) and 59)

D.1. Table providing the formulae 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	$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$
η_{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 6

The ε 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 $LFG_{flare,y} * w_{CH4} * D_{CH4}$ *)*

$$\varepsilon_{MD\ electrucity} = \sqrt{(err_{PT03})^2 + (err_{TT02})^2 + (err_{FT04\_a})^2 + (err_{GA02})^2 + (err_{GA01})^2}$$

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

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 :

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

D.2. Description and consideration of measurement uncertainties and error propagation

The data parameters are measured round 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.

D.3. GHG emission reductions calculation

The data are available in the **ER calculation sheet_** ***month_200X_*** and provided to DOE

For PE_{flare} calculation details and equivalent error calculation and correction see also **ER calculation sheet_** *month_200X.*.

The Table 7 shows the Baseline Emission and the Project Emission during the monitoring period.

Period	*BE* [t $CO_{2\ eq}$]	*PE* [t $CO_{2\ eq}$]
1st July – 31 July 2009	8,500.33	21.21
1st August – 31 August 2009	7,548,01	36.04
1st September – 30 September 2009	7,642.05	0.30
1st October – 31 October 2009	7,735.47	21.08
1st November – 30 November 2009	8,106.47	0.48
1st December – 31 December 2009	8,516.94	0.10
TOTAL	**48,049.26**	**79.21**

Table 7

D.3.3. Leakage:

No leakage calculation is required

D.3.4. Summary of the emissions reductions during the monitoring period:

The Table 7 shows the Emission Reduction during the monitoring period.

Period	[t $CO_{2\ eq}$]
1st July – 31 July 2009	**8,479.12**
1st August – 31 August 2009	**7,511.96**
1st September – 30 September 2009	**7,641.74**
1st October – 31 October 2009	**7,714.40**
1st November – 30 November 2009	**8,105.99**
1st December – 31 December 2009	**8,516.84**
TOTAL ER REQUESTED	**47,970**

Table 8

ANNEX I: monitoring equipment location

LEGEND			
FT03_a	Flow Meter (total)	TT01	Temperature meter
FT04_a	Flow Meter (flare)	TT02	Temperature meter
FT05_a	Flow Meter (engine)	TT03	Temperature meter
GA01	Methane content analyser	TT04	Temperature meter
GA02	Exhaust gas analyzer	TT05	Temperature meter
EM01	Electricity meter	PT01	Pressure meter
HC01	Engine hours counter	PT02	Pressure meter
HC02	Plant hours counter	PT03	Pressure meter
		PT04	Pressure meter
		PT05	Pressure meter