Quezon City Controlled Disposal Facility Biogas Emission Reduction Project

(QCCDFBERP)

CDM Registration Reference number 1258

MONITORING REPORT

(Monitoring period: September 1st 2008, to June, 30th - 2009)

2nd verification –version 0

July 2009

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 this 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 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 third year.

The plant was completed and commissioned in March 2008.

At the time June 2009 the network included 64 wells 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.

Each well is connected to a controlling substation (total of 4 units at present) ; Sub-stations 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 capacity of the electricity generator presently installed is 200 kW. Currently, the electricity is produced only for the internal consumption of the plant.

The improvements from the start of plant activities have been directed, for the biogas collection system, to the new wells building (16 in addition) plus 1 substation; for the burning plant a new flow meters in the main, flare and engine line , has 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.
A previous garbage disposal activity from Disposal Facility Management Office , will request in the next months, the partial disconnection of some wells located in the Old Mound area ; an additional biogas collection system for the capitation in the affected area has been foreseen.

A.3.2. Changes against the PDD
No major changes were made.

A.4. Monitoring period:
From September 1st, 2008, to June 30th, 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 9 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 9th 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 a same deviation, accepted on EB n. 45 11-13 February 2009, will be again 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 a same deviation, accepted on EB n. 45 11-13 February 2009, will be again requested.

A.7. Changes since last verification:

This is the second 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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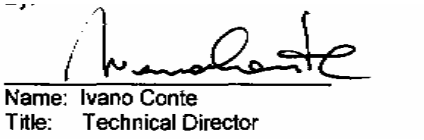

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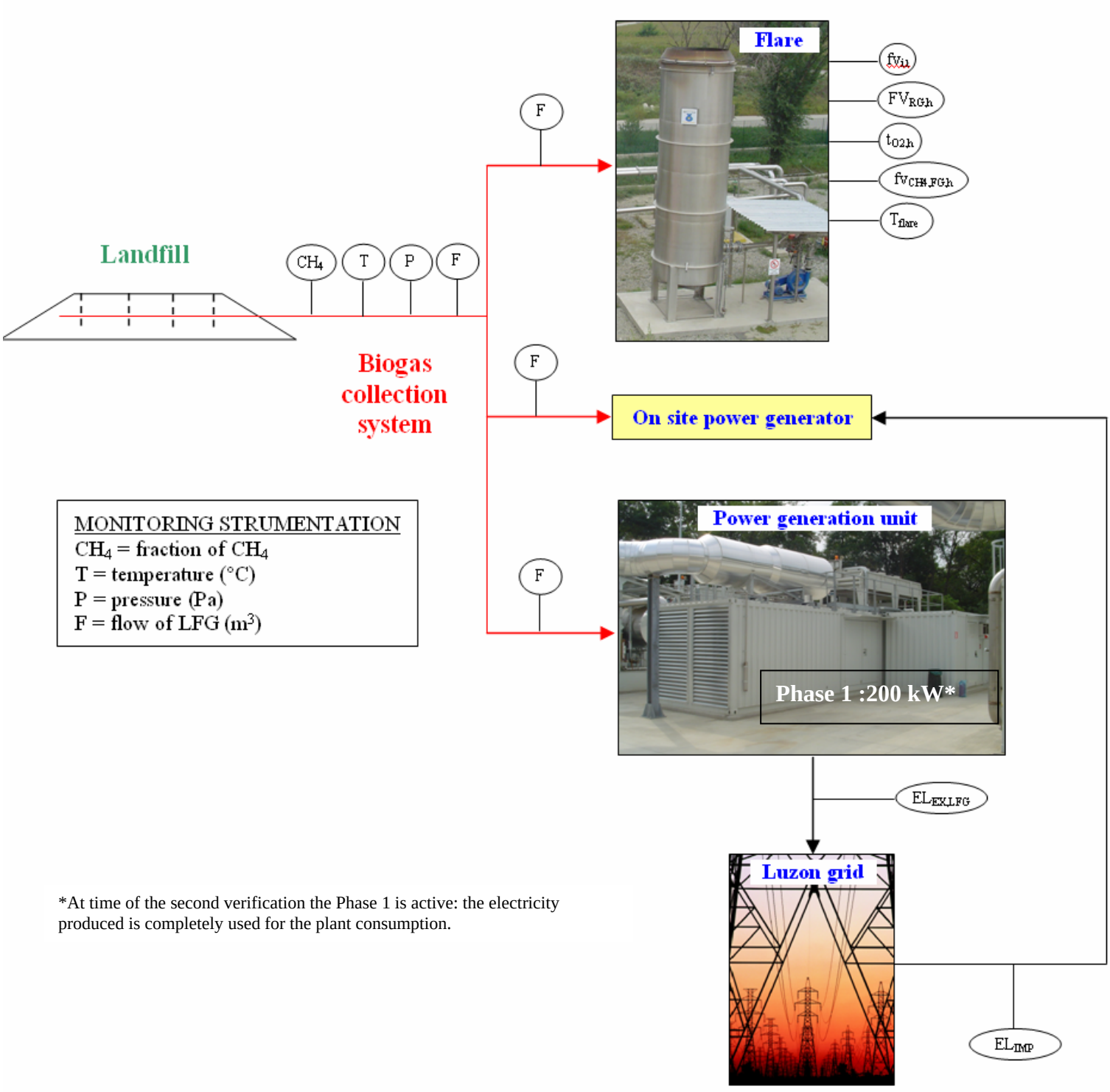
SECTION B. Key monitoring activities according to the "QCCDFBERP Monitoring plan" for the monitoring period stated in A.4. (referring to Decision 17/CP.7, Annex H, paragraph 53 (a) – (d) on data collection and archiving)

B.1. Monitoring equipment:

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



*At time of the second verification the Phase 1 is active: the electricity produced is completely 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	Flow Meter	RMG	TRZ-03 -34807	Main pipeline	0.37% / 0.26 %	130-2500 m^3/h	7 years	21/5/2007	RMG Messtechnik (authorized by PTB-DE)
FT03_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075923 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696153	Main pipeline	0.025%	130-2500 m^3/h	2 years	28/2/2009	EMERSON – PROCESS MANAGEMENT
FT04	Flow Meter	RMG	TRZ-03 - 34808	Flare pipeline	0.49% / 0.26 %	130-2500 m^3/h	7 years	29/5/2008	RMG Messtechnik (authorized by PTB-DE)
FT04_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075924 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696152	Main pipeline	0.025%	130-2500 m^3/h	2 years	28/2/2009	EMERSON – PROCESS MANAGEMENT
FT05	Flow Meter	RMG	TRZ-03 - 34809	Engine pipeline	0.11 / 0.26 %	13-250 m^3/h	7 years	23/5/2007	RMG Messtechnik (authorized by PTB-DE)
FT05_a	Flow Meter	EMERSON - ROSEMOUNT	485 - 0075925 3051S1CD1A2E12A1AB 4D2E1L4Q4 -8696154	Engine pipeline	0.025%	13-250 m^3/h	2 years	28/2/2009	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	13/3/2009	SIEMENS
TT02	Temperature meter	ELSI Srl	Probe Model: G1.U10-P20-B0150-S00, Transmitter Model: Y1-SEM203P - Serial number 08-07/290	Main pipeline	0.27 % / 0.12%	0-250 C°	2 years	12/9/2007	Elsi Calibration center
PT04	Pressure meter	ABB	264HS-6407024078	Main pipeline	0.075%	0-250 mbar	2 years	25/9/2007	ABB quality test check

ID	Type	Manufacturer	Model -Serial Number	Location	Error / Uncertainty	Range	Calibration frequency	Last calibration	Calibration Entity
TT03	Temperature meter	ELSI	Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 10-05 9387	Flare	0.09% / 0.19%	0-1600 C°	2 years	12/9/2007	Elsi Calibration center
TT04	Temperature meter	ELSI	Probe Model: M1.U07-S00-M00400.1-S20, Transmitter Model: Y1-SEM210/S - Serial number 10-07/748	Flare	0.09% / 0.19%	0-1600 C°	2 years	12/9/2007	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	13/3/2009	SIEMENS
EM01	Electricity meter	GENIUS	EDMI N680 - 206584765	Main Electrical Panel	1%	5(20) A – 240V	2 years	10/3/2009	ERC Philippines
FT01	Flow meter line “A””	EMERSON - ROSEMOUNT	285G050ZCSP1S17 - 0053154	Line “A	0.075%	0-1200 m^3/h	2 years	3/9/2007	ABB quality test check
		ABB	264DS - 6407021990						
FT02	Flow meter line “B”	EMERSON - ROSEMOUNT.	285G050ZCSP1S17 - 0050959	Line “B”	0.075%	0-1200 m^3/h	2 years	31/8/2007	ABB quality test check
		ABB	264DS - 6407021989						
HC01	Engine hours counter	REVALCO	RK46 – 42.01	Engine	$2.3*10^{-4}$ %	0-999999 h	Not requested	10/1/2007*	Revalco

Tab.1

The FT03_a, FT04_a, FT05_a flow meter, have been installed respectively on 27th March 2009, 27th March 2009, and 10th June 2009 with the same function of original FT03, FT04, FT05 to permit the maintenance operations and realize a more reliable flow measuring system.
The TT04 was installed on 9th November 2008.
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”.
*(date related to HC01 Conformity Declaration)

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 2

B.2.2. List of variables

Parameter	Description	Unit of measure	Source
$LFG_{Total,h}$	Amount of landfill gas flared	m^3/h	Directly measured
$LFG_{flare,h}$	Amount of landfill gas flared	m^3/h	Directly measured
$LFG_{electricity,h}$	Amount of landfill gas combusted in power plant	m^3/h	Directly measured
$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour *h*	m^3/h	Directly measured
$f_{vCH4,h}$	Volumetric	-	Directly measured

Parameter	Description	Unit of measure	Source
	fraction of methane in the 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
$f_{vCH4,FG,h}$	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
T_{flare}	Temperature in the exhaust gas of the flare	°C	Directly measured
T	Temperature of the landfill gas	°C	Directly measured
P	Pressure of the landfill gas	mbar	Directly measured
$EL_{EX,LFG}$	Total amount of electricity exported out of the project boundary	MWh	Directly measured
EL_{IMP}	Total amount of electricity imported to meet project requirements	MWh	Directly measured

Table 4

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 5 feet in just 10 months of gas and leachate extraction. This means that the mounds have better compaction and the quantity of perched water and leachate was also reduced thereby improving stability of the slopes of the dump. 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.

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 5

The ε equivalent error calculation is applied the following variable:

$$\varepsilon_{PE\ flared} = \sqrt{(err_{PT04})^2 + (err_{TT03})^2 + (err_{FT04})^2 + (err_{GA02_{ch4}})^2 + (err_{GA02_{02}})^2}$$

$$\varepsilon_{MD\ flare\ d\ before\ PE\ reduction,\ y} = \sqrt{(err_{PT04})^2 + (err_{TT03})^2 + (err_{FT04})^2 + (err_{GA01})^2}$$

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

$$\varepsilon_{MD\ electrucity} = \sqrt{(err_{PT03})^2 + (err_{TT03})^2 + (err_{FT03})^2 + (err_{GA02})^2 + (err_{GA01})^2}$$

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

Where the err_{aabb} is the sum of error plus uncertain associated to the instrument involved in the variable calculation (see table 1)

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 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.

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 6 shows the Baseline Emission and the Project Emission during the monitoring period.

Period	*BE* [t $CO_{2\ eq}$]	*PE* [t $CO_{2\ eq}$]
1st September – 30 September 2008	**5,723.77**	**1.17**
1st October – 31 October 2008	**6,665.10**	**22.09**
1st November – 30 November 2008	**7,340.14**	**0.98**
1st December – 31 December 2008	**6,756.91**	**6.00**
1st January – 31 January 2009	**8,519.41**	**5.74**
1st February – 28 February 2009	**7,550.30**	**5.83**
1st March – 31 March 2009	**8,745.31**	**5.80**
1st April – 30 April 2009	**8,360.13**	**5.79**
1st May – 30 May 2009	**8,828.31**	**5.78**
1st June – 30 June 2009	**8,466.55**	**8.38**
TOTAL	**76,956**	**68**

Table 6

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 September – 30 September 2008	5,722.60
1st October – 31 October 2008	6,643.02
1st November – 30 November 2008	7,339.17
1st December – 31 December 2008	6,750.92
1st January – 31 January 2009	8,513.67
1st February – 28 February 2009	7,544.46
1st March – 31 March 2009	8,739.51
1st April – 30 April 2009	8,354.33
1st May – 30 May 2009	8,822.53
1st June – 30 June 2009	8,458.17
TOTAL ER REQUESTED	**76,888**

Table 7

ANNEX I: monitoring equipment location

LEGEND			
FT01	Flow meter line “A””	TT01	Temperature meter
FT02	Flow meter line “B”	TT02	Temperature meter
FT03	Flow Meter (total)	TT03	Temperature meter
FT03_a	Flow Meter (total)	TT04	Temperature meter
FT04	Flow Meter (flare)	TT05	Temperature meter
FT04_a	Flow Meter (flare)	PT01	Pressure meter
FT05	Flow Meter (engine)	PT02	Pressure meter
FT05_a	Flow Meter (engine)	PT03	Pressure meter
GA01	Methane content analyser	PT04	Pressure meter
GA02	Exhaust gas analyzer	PT05	Pressure meter
EM01	Electricity meter	HC01	Engine hours counter