Gold Standard Monitoring Report

CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation project, Thailand

Emission Reductions: **14,657 tCO_2**

UNFCCC Reference No.: 2141
GS Reference No.: GS775

Pre CDM GS Monitoring Report
Monitoring Period: 25/05/2008 to 24/03/2009

Version: 1.5
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1. Project Background

By means of this Monitoring Report greenhouse gas emission reductions achieved by the project activity "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" are being estimated and presented as per the method that is described in the registered PDD and GS Annex..

The project activity experiences no change in terms of location address or ownership. During this monitoring period, the project proponent has used a few deviations for some of the monitoring parameters. The related deviations for this monitoring period are described in the Annex-2 to this document. The Gold standard monitoring parameters are included in Annex-1 of this report.

The relevant dates for the project activity are:

Event	Date	Reference
Construction	04/08/06	Purchase order for civil works
Commissioning of UASB	03/11/07	Certificate of Civil Mechanical and Electrical Completion[1]
Commissioning of gas engines	29/11/08	First date of monitoring record for biogas sent to gas engines
Registration under UNFCCC	24/03/09	UNFCCC website
Revision of monitoring plan	12/08/10	UNFCCC website

There is no configuration change in the project activity as compared to the registered PDD.

Further background information on the project activity can be found in the registered Project Design Document on the following link:
http://cdm.unfccc.int/Projects/DB/RWTUV1218617500.62/view

This monitoring period covers the pre CDM registration period under the Gold Standard guidelines.

- ✓ Date of CDM Registration: 25th March 2009 (pre-registration credits can be claimed for 1 yr prior to this date as per GS guidelines)
- ✓ Date of Gold Standard Registration: 24th May 2010 (pre-registration credits can be claimed for 2 year prior to this date as per GS guidelines)

The monitoring period of project activity is based on GS guidelines and registration dates. The start of crediting period from 25th May 2008 is governed by the GS registration of 24th May 2010.

2. Monitoring Background

Section B.6 and B.7 of the registered PDD provides all details in regard to calculation of emission reductions and the monitoring plan to be followed by the project activity. Both the emission

[1] Certificate issued by technology provider is provided.

reduction calculations and the monitoring plan are based on the approved CDM methodology AM0022 version 4.

3. Monitoring Data used

3.1 Monitoring period

This is the pre registration GS VER monitoring report of this project activity. It covers the period from 25th May 2008 to 24th March 2009 (Both days included)[2]

As per the registered PDD, the emission reductions expected for this time period shall be approximately 81,179 tCO2 equivalent (calculated based on pro-rata basis for the 305 days of the monitoring period and not a complete year). However the lower emission reductions reported are due to lower levels of COD input, lower than expected waste water volumes (depends on starch plant operation) and less usage of biogas for useful purposes which leads to a lot biogas being flared. During this period, the gas engine was not operational for a major part of monitoring period due to technical problems[3]. A lot of biogas had to be flared during the monitoring period as the gas engines were not operated.

3.2 Monitoring parameters

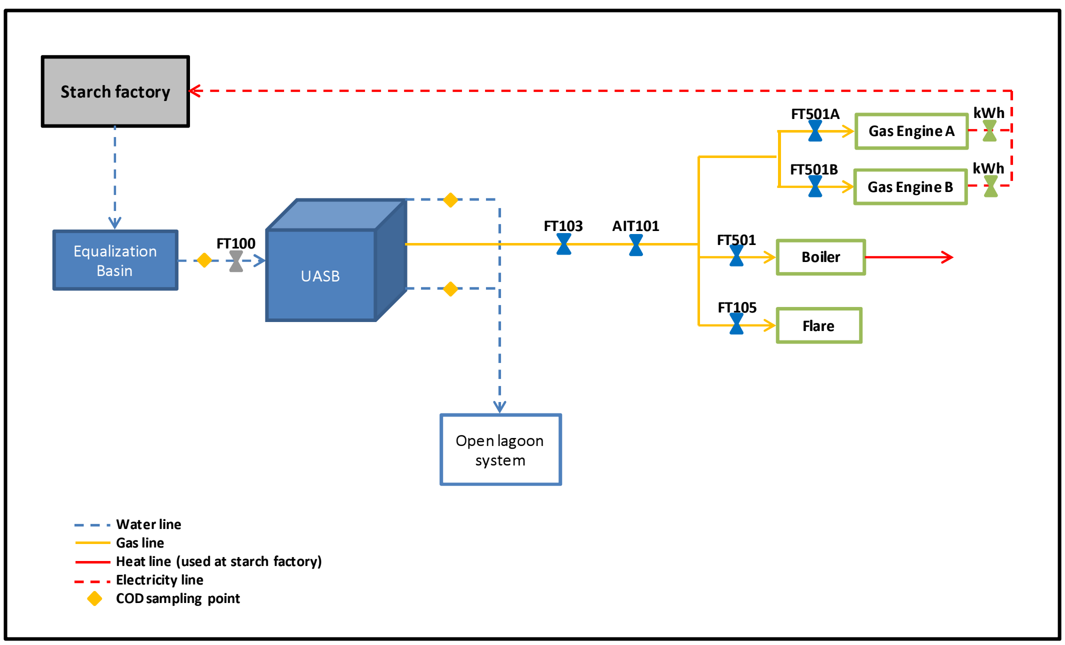

Figure 1. Project activity flow diagram

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[2] The date of UNFCCC registration is 25th March 2009, and GS registration is 24th May 2010. Thereby the proponent has chosen the monitoring period as per GS regulations, which allows the start of pre registered credits for no earlier than 2 years before GS registration.

[3] Log records and copy of spare part ordering document provided.

AM0022 ID	Diagram in PDD	Tag no. in Figure 1	Comments
ID1	FM1	FT100	as per the plant layout from SCADA system
ID16	FM2	-	not available in actual project activity as it is has no affect on baseline and project emissions of project activity. (AM0022 ID16)
ID2	FM3	-	not available in actual project activity
-	GM1	FT103	as per the plant layout from SCADA system – total gas meter
ID9	GM2	FT105	as per the plant layout from SCADA system - gas sent to flare.
ID5	GM3	FT501	as per the tag of equipment used in the project – gas sent to boiler.
ID10	GM4	FT501A, FT501B	as per the plant layout from SCADA system- gas sent to gas engines.
ID7	PM1	-	as per the tag of equipment used in the project. Power generation from project.
ID11	-	AIT101	as per the tag of equipment used in the project – methane percentage measurement in biogas.
ID3 / ID4	Colorimeter	-	The inlet COD of the reactor is monitored from samples at the inlet of reactor. The waste water has two outlet streams. The COD samples are monitored from both the streams, and a daily average value is used for calculation.

The table above is provided as a translation of the monitoring parameter identities applied in different documents such as the approved methodology AM0022, the flow diagram in the registered PDD and Figure 1 above. A complete list of all monitoring parameters as per monitoring plan in the registered PDD is provided below. Further details with respect to applied monitoring equipment are provided at the end of this section.

Parameters	Unit	Description	Source of Data
AM0022 ID1	m^3	Wastewater flows entering the project treatment facility.	On-site measurement
AM0022 ID2	m^3	Wastewater flow leaving the project treatment facility	Same as input waste water amount - hydrological balance
AM0022 ID3	kg COD/m^3	COD concentration of the wastewater entering the new anaerobic digestion system	On-site measurement using colorimeter.
AM0022 ID4	kg COD/m^3	COD concentration of the wastewater leaving the new anaerobic digestion system.	On-site measurement using colorimeter.
AM0022 ID5	Nm^3	Volume of biogas sent to facility heaters	On-site measurement
AM0022 ID7	MWh	Electricity generated from collected biogas	On-site measurement - Meters available.
AM0022 ID8	m^3	Fossil fuel volume equivalent required to generate same amount of heat generated from the biogas collected in anaerobic treatment facility.	Calculated based on amount of biogas sent to the boilers and crosschecked using historic specific heavy fuel oil consumption.
AM0022 ID9	Nm^3	Biogas sent to flares	On-site measurement available from Nov 2008. Before the meter installation balance of biogas.
AM0022 ID10	Nm^3	Biogas sent to genset	On-site measurement.
AM0022 ID11	%	Methane concentration in biogas	On-site measurement . Installed on 25th Sep 2008. Refer to Deviation 1 in Annex-2 of the Monitroing Report. The methane analyser is based on Infra Red technology
AM0022 ID12	tCO_2e	Project emissions from flaring of the residual gas stream	Calculated base on caluclation procedure determined in the Tool to determine project emissions from flaring gases containing
AM0022 ID13	$Tonnes/m^3$	Amount of chemical oxidising agents entering system boundary	On-site measurement using colorimeter.
AM0022 ID14	%	Gen set combustion efficiency (combustion of methane)	On-site measurement, Refer to Deviation - 2 in Annex-2 of the Monitroing Report
AM0022 ID15	%	Heating system combustion efficiency (combustion of methane)	On-site measurement, Refer to Deviation - 2 in Annex-2 of the Monitroing Report
AM0022 ID16	m^3	Volume of flow of wastewater directly to the current wastewater treatment system	No effect on the Emission reduction estimate as this parameter is not part of any calculation formulae. Refer to Deviation 3 in Annex 2 of
AM0022 ID17	%	Loss of biogas from pipeline	Piping leakage is checked using pressure drop tests once in every 3 to 4 years during major maintenance. Mobile gas detectors are often used at project site by technology provider for random checking.
AM0022 ID18	t COD	Organic material removed from wastewater facility	On site measurement using the weigh bridge available at the project site.
AM0022 ID19	J/Nm^3	Biogas calorific value	Measured/calculated through ID11 and calculation using perfect gas eqution, assuming that only the methane content contributes to the NCV of the biogas.
-	min	Flame detection period	Amount of minutes per hour where a flame is detected.
-	Min	Period of biogas being sent to the flare	Amount of minutes per hour where biogas is sent to the flare.

Data Management and Emission Reduction Reporting:

The data management is done in the following manner. For laboratory monitored parameters the records are written into the log sheets on daily basis and transferred to electronic files.

- Data acquisition from gas and waste water flow meters is executed through the process control unit on daily basis and the values are input manually into the log books in paper and electronic format. This is done by plant operator. In future, the project proponent would implement automatic logging of data into csv files, to generate automated log files.
- The parameters monitored in laboratory by lab in charge and lab operator are entered into log sheets which are later transferred to electronic log file i.e. excel sheet.

- The values from electronic log sheet are used for calculation of emission reductions estimation.
- The data is regularly backed up in form of excel sheet formats on a different computer and also a portable storage system such as compact disc.
- The data is archived for period of 2 years after the crediting period in form of soft files.

The reporting of monitored parameters is done on a daily basis by the plant staff in form of daily log reports. The data is compiled and inserted by the responsible staff into an excel report template and daily report format, which is used for calculation of emission reductions and daily reporting respectively. The head of QC team sends the printout of summary daily report to the plant manager and the compiled data to the managing director via emailThe compiled excel report is further sent to the project consultants for detailed emission reduction analysis. The managing director and project consultant interact on regular basis to discuss emission reduction reporting. The details of the reporting procedure are explained in more detail in the table, which summarizes the responsibility of the staff at the project site. The table can be referred to in the section below.

In addition, all the events related to the monitoring plan of CDM project activity are reported on occurrence basis to the plant manager and managing director. For e.g. if the biogas leakage is detected, it is first reported to plant manager and managing director for necessary action. This reporting is not a regular phenomenon as this happens only in case of events.

The procedural documentation for the data management shall be included in the plant operation and maintenance procedures in future.

QA / QC Procedures:

The time period of this monitoring report is prior to the registration of project at UNFCCC and the project proponent was in process of establishing the monitoring and QA / QC procedure during this time period.

- The calibrations for all the monitoring devices are available, relevant to the monitoring period. The QC team ensures the timely calibrations of the monitoring devices, data acquisition and storage of data.
- Since this is period prior to project registration, the gaps in the QA / QC are answered in line with EB guidance and in a conservative manner. The methane percentage measurement and monitoring of the combustion efficiency of gas engine and the boiler are addressed using conservative approaches.
- The roles and responsibilities of the project's staff are briefly tabulated below.

Position	Responsibilities
Head of Quality Control	- Checks the completeness of the parameters monitored inserted into the log books and provides the daily report based on the reporting procedures for the biogas plant[4] - Sends the daily report in print format to the plant manager and by email to managing director - Sends aggregated reports via email to the project consultant on a regular basis[5] - Transfers all of the parameters monitored in log books into the electronic log file (excel report) on daily basis - Ensures the timely calibrations of the monitoring equipment

[4] The document had been submitted to the DOE

[5] As defined in contracts between the project consultant and the project owner (submitted to the DOE)

	- Regularly backs up the data from the excel reports
Quality Control Staff	- Takes samples and analyzes characteristics of wastewater based on the reporting procedures for the biogas plant
Biogas system controller	- Fills in the data monitored for biogas system from the process control unit to the log books based on the reporting procedures for the biogas plant
Power system controller	- Fills in the data monitored for power system from the process control unit to the log books based on the reporting procedures for the biogas plant
Plant Manager	- Supervises and signs off the daily report

The operation and maintenance at the project site is in line with the standard / procedural requirements recommended by the technology provider. The adherence to these procedures is ensured by the operation and maintenance staff. Based on these operation and maintenance procedure, a concise checklist is developed at project site which lists all the precautions and checks to be undertaken for normal operation and safety assurance. In addition to this, there is an emergency preparedness plan in place at the project location to face any unexpected circumstances at the project site. The MR is revised to mention about the availability of emergency preparedness plan.

List of serial numbers of main monitoring equipments are provided in the table below;

Flow meter	Serial number	Position	Manufacturer / type	Accuracy	Calibration record
FT100 / FM1	A06 42633	Wastewater volume flow to UASB	Krohne / Magnetic Flow-meter	±0.3%	Calibration by Krohne dated 20/9/2006
					Calibration by Miracle International Technology dated 10/9/2009

Gas meter	Serial number	Position	Manufacturer / type	Accuracy	Calibration record
FT103 / GM1	265DS6600 032639	Total biogas generated from UASB	ABB / Differential Pressure Transmitter	±0.04%	Calibration by DWS dated 5/04/2007
					Calibration by Miracle International Technology dated 7/9/2009
FT105 / GM2	265DS6600 028458	Biogas sent to Flare	ABB / Differential Pressure Transmitter	±0.04%	Calibration by DWS dated 18/04/2008
					Calibration by Miracle International Technology dated 7/9/2009
FT501 / GM3	91FA19282 639	Biogas sent to Boiler	Yokogawa / Differential Pressure Transmitter	±0.04%	Calibration by DWS dated 26/04/2007
					Calibration by Miracle International Technology dated 7/9/2009
FT501A / GM4	265DS6600 032493	Biogas sent to Engine A	ABB / Differential Pressure Transmitter	±0.04%	Calibration by DWS dated 18/04/2008
					Calibration by Miracle International Technology dated 7/9/2009
FT501B / GM4	265DS6600 028459	Biogas sent to Engine B	ABB / Differential Pressure	±0.04%	Calibration by DWS dated 21/04/2008

Gas meter	Serial number	Position	Manufacturer / type	Accuracy	Calibration record
			Transmitter		Calibration by Miracle International Technology dated 7/9/2009

Equip-ment	Serial number	Position	Manufacturer / type	Accuracy	Calibration record
AIT101 / ID11	ARYK-0131	Methane Analyzer for Biogas from UASB[6]	Drager / CH_4 Analyzer	±1%	Calibration by Drager safety dated 14/12/2007
					Calibration by Miracle International Technology dated 2/10/2009
	A004997	Supply of power to grid / starch plant	DEIF / Multi – Line PPU/2/GS[7]	1%	Calibration by Power Maintenance and Servic-es dated 21/2/2010
	2005352	Weigh bridge at the project site	Linear / PM-02	N/A	Certification by Central Bureau of Weights and Measures dated 2/4/2007[8]
Colorim eter / ID3, ID4	070890C64 902	Concentratio n of COD. On-site measureme nt	Hach / Portable Colorimeter	±1%	Standard solution is used for the measurement of COD, the certificate of standard solutions provided.
Colorim eter / ID13	070890C64 902	Concentratio n of sulphate ion. On-site measureme nt	Hach / Portable Colorimeter	±0.24%	Standard measurement method in accordance with USEPA method 375.4 for wastewater.

The calibration interval for all equipments is once a year except the weigh bridge, which the certificate refers to 2 years of validity.

[6] The methane analyzer is based on the Infra Red technology. Please refer to technical specifications. File: Drager.pdf

[7] The manual states the accuracy to be class 1.0 as per IEC 6680. This refers to accuracy of 1%.

[8] The interval for calibration of Weigh Bridge is not available in local regulations. The certificate issued by local authorities refers to 2 year limit for expiry of the calibration certificate.

4. Calculation methodology and monitoring results

Emission reductions were calculated on the basis of formulae provided in AM0022 version 4 and applied to the project on the basis of an ex-ante calculation in the registered PDD.

The following equations are used to calculate emission reductions based on monitored data.

A) Baseline emissions

1. The daily waste water entering the system is multiplied by the daily COD load to get the total amount of COD entering the treatment system. The amount is denoted by M_{input_total}. In the baseline case, without the new anaerobic treatment facility, no wastewater material would degrade before entering the lagoon system and all the organic material to be treated would have entered the lagoon system.

Formula 11 (baseline)	**2008**	**2009**
$M_{lagoon\_input\_BL}$ (kg COD)	5,141,163	3,089,371
M_{input_total} (kg COD)	5,141,163	3,089,371

2. Result from 1 is multiplied by the total organic removal ratio of the lagoon determined ex-ante (98.90%) to calculate the total amount of organic material removed in the baseline system. $M_{lagoon\_total\_BL}$

$$M_{lagoon\_total} = M_{lagoon\_input} \cdot R_{lagoon}$$

Formula 5 (baseline)	**2008**	**2009**
R_{lagoon} (%)	98.90%	98.90%
$M_{lagoon\_input\_BL}$ (kg COD)	5,141,163	3,089,371
$M_{lagoon\_total\_BL}$ (kg COD)	5084611	3055388

3. The amount of organic material degraded aerobically in the lagoon system is calculated as the product of a default value for surface aerobic losses of organic material (254kg COD/ha/day) total lagoon area and number of days the plant is operating during the monitoring period. $M_{lagoon\_aerobic\_BL}$ (kg COD)

$M_{lagoon\_aerobic} = COD_{loss\_aerobic} \times A_{lagoon\_surface} \times dd_{year}$

(baseline)	**2008**	**2009**
Surface loss (kg COD/day/ha)	254	254
Area of lagoon	25	25
No. of days of WW system operat.	222	83
$M_{lagoon\_aerobic\_BL}$ (kg COD)	1,419,850	530,845

4. The result from 1 is used to determine the amount of COD deposited in the lagoon by multiplying it with the organic material deposition ratio of the lagoon fixed ex-ante (7.05%). $M_{lagoon\_deposition\_BL}$

$$M_{lagoon\_deposition} = M_{lagoon\_input} \cdot R_{deposition}$$

Formula 6 (baseline)	2008	2009
$R_{deposition}$ (%)	7.05%	7.05%
$M_{lagoon\_input\_BL}$ (kg COD)	5,141,163	3,089,371
$M_{lagoon\_deposition\_BL}$ (kg COD)	362572	217873

5. The waste water volume entering the system is multiplied by the concentration of oxidant i.e. Sulphate and a pre determined constant of COD loss per kg oxidant present in waste water (0.651 kg COD/kg Q_{ox}) to determine COD loss due to chemical oxidation. Sulphate concentration is measured at the exit of the starch plant and the maximum value monitored during the monitoring period is used to estimate the COD loss as a conservative approach.

$M_{lagoon\_chemical\_ox\_BL}$

$M_{lagoon\_chemical\_ox}$ = WW_{in} x SO_4^{2-}_concentration x $COD_{loss\_chem\_ox}$

(baseline)	2008	2009
WW_input_BL (m3)	299,106	213,553
Sulphate conc. (kg Qox/m3)	0.540	0.540
$COD_{loss\ chem\ ox}$ (kg COD/kg Qox)	0.651	0.651
$M_{lagoon\_chemical\_ox\_BL}$ (kg COD)	105,148	75,072

6. Results from 2, 3, 4 and 5 are used to determine the total amount of organic material removed by anaerobic processes in the lagoon system in the baseline scenario $M_{lagoon\_anaerobic\_BL}$

$$M_{lagoon\_anaerobic} = M_{lagoon\_total} - M_{lagoon\_aerobic} - M_{lagoon\_chemical\_ox} - M_{lagoon\_deposition}$$

Formula 3 (baseline)	2008	2009
$M_{lagoon\_total\_BL}$ (kg COD)	5,084,611	3,055,388
$M_{lagoon\_aerobic\_BL}$ (kg COD)	1,419,850	530,845
$M_{lagoon\_chemical\_ox\_BL}$ (kg COD)	105,148	75,072
$M_{lagoon\_deposition\_BL}$ (kg COD)	362,572	217,873
$M_{lagoon\_anaerobic\_BL}$ (kg COD)	3,197,041	2,231,597

7. The result from 6 is used to determine the baseline emissions using an emission factor for methane from COD (fixed at 0.21kg CH4/kg COD) and multiplying with 21 (GWP potential of methane) $E_{CH4\_lagoons\_BL}$

$$E_{CH4\_lagoons} = M_{lagoon\_anaerobic} \cdot EF_{CH4} \cdot GWP_{CH4} / 1000$$

Formula 2 (baseline)	2008	2009
$M_{lagoon\_anaerobic\_BL}$ (kg COD)	3,197,041	2,231,597
EF_{CH4} (kg CH_4/kg COD)	0.210	0.210
GWP_{CH4} (tCO_2e/tCH_4)	21	21
$E_{CH4\_lagoons\_BL}$ (tCO_2e)	14,099	9,841

8. In calculating the CO_2 emissions from on-site heat displaced by biogas, the amount of fossil fuel replaced is calculated. This amount is calculated on the basis of the NCV of

HFO fixed ex-ante and the NCV of biogas (which is the product of the NCV of methane and the methane concentration). E_{CO2_heat}

The daily methane percentage value is multiplied by NCV of methane. For the time period when no methane percentage data is available, the lower limit of the 99% confidence interval is used for conservative estimation of baseline emissions, and for higher value of interval is used for project emission estimations. Please refer to Deviation 1, Annex 2 for more details. The deviated values are used only for days when the methane readings are not available i.e. from 25th May to 24th Sep 2008. For the days when the monitoring values are available, the actual monitored values are used for calculation.

The methane percentage values used for the time period of non-availability of methane (25th May to 24th Sep 2008) data is as follows:

Methane Percentage	For BE	For PE
	62.718%	66.349%

In the following table the values represented for the 2008 only refers to the average value for the time period when the actual readings are available. The representation in the following table has no influence on the actual calculations as the calculations are based on daily values.

$$E_{C02\_heat} = F \cdot NCV \cdot EF$$

Formula 9 (baseline)	2008	2009
Biogas to boiler	1,250,532	584,280
F (t)	718	350
F_biogas_HFO (tHFO/Nm3)	0.00057	0.00060
NCV (MJ/Nm3) - Methane	35.94	35.94
Methane % in biogas	64.56%	67.35%
NCV (MJ/Nm3) - Biogas	23.20	24.21
NCV (TJ/t) - Fuel oil	0.0404	0.0404
EF (tCO2/TJ)	77.40	77.40
E_{CO2_heat} (tCO_2)	**2,221**	**1,094**

9. The baseline emissions from power generation are calculated by multiplying the amount of electricity displaced by the electricity generation from the biogas collected from the bio-digester by the grid emission factor fixed ex-ante (0.52 tCO2/MWh). During this monitoring period, the power generated by the gas engine is continuously monitored and displayed on the gas engine panel.
   $E_{CO2\_power} = EL \times CEF$

Formula 10 (baseline)	2008	2009
Biogas - Generator (Nm3)	279,133	439,603
EL (MWh)	249	1,023
CEF (tCO_2/MWh)	0.520	0.520
E_{CO2_power} **(tCO_2)**	**129**	**532**

10. The aggregated baseline emissions are sum of 7, 8 and 9.

$$E_{BL} = E_{CH4\_lagoons\_BL} + E_{C02\_heat\_BL} + E_{CO2\_power\_BL}$$

Formula 8 (baseline)	2008	2009
E_{BL} (tCO_2e)	16,449	11,467
$E_{CH4\_lagoons\_BL}$ (tCO_2e)	14,099	9,841
$E_{CO2\_heat\_BL}$ (tCO_2)	2,221	1,094
$E_{CO2\_power\_BL}$ (tCO_2)	129	532

B) Project emissions

Total project emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system and from the new bio-digester, from incomplete biogas combustion and from biogas leakage.

The formulas used are same as above but parameters used are with different notations (BL is removed from subscript) to indicate that these parameters represent Project emissions.

11. The waste water output is multiplied by the COD concentration from the outlet of the project facility on a daily basis to estimate daily COD load. The aggregated total gives the amount of COD entering the lagoon system in project activity. The removal efficiency of reactor (R_{NAWTF}) is chosen conservatively as the minimum between the calculated value using the aggregated COD removal amounts and the design value (90%) used ex-ante in the registered PDD. This ensures that project emissions are not under estimated by using higher efficiency of the project activity.

Formula 4 (project)	2008	2009
$\mathbf{M}_{input\_total}$ (kg COD)	5141163	3089371
R_{NAWTF} (%)	85.53%	87.08%
$M_{\mathbf{lagoon\_input}}$ **(kg COD)**	743718	399135

12. The result from 11 is multiplied by the lagoon efficiency determined ex-ante (98.9%) to determine the total amount of organic material removed in the lagoon system. M_{lagoon_total}

Formula 5 (project)	2008	2009
$\mathbf{R}_{lagoon}$ (%)	98.90%	98.90%
M_{lagoon_input} (kg COD)	743,718	399,135
$M_{\mathbf{lagoon\_total}}$ **(kg COD)**	735538	394744

13. The result from 12 is used to determine the amount of COD lost through deposition by multiplying it by the organic material deposition ratio of the lagoon fixed ex-ante (7.05%). $M_{lagoon\_deposition}$

Formula 6 (project)	2008	2009
$\mathbf{R}_{deposition}$ (%)	7.05%	7.05%
M_{lagoon_input} (kg COD)	743,718	399,135
$M_{\mathbf{lagoon\_deposition}}$ **(kg COD)**	52432	28139

14. The amount of organic material degraded aerobically in the lagoon system is calculated as the product of a default value for surface aerobic losses of organic material (254kg COD/ha/day) total lagoon area and number of days the plant is operating during the monitoring period.

	2008	2009
Surface loss (kg COD/day/ha)	254	254
Area of lagoon	25	25
No. of days of WW system operat.	222	83
$M_{lagoon\_aerobic}$ (kg COD)	1,419,850	530,845

15. The waste water volume entering the system, is multiplied by the concentration of oxidant i.e. Sulphate, and a pre determined constant of COD loss per kg oxidant present in waste water (0.651 kg COD/kg Qox) to determine COD loss due to chemical oxidation. $M_{lagoon\_chemical\_ox}$

	2008	2009
WW_input (m3)	299,106	213,553
Sulphate conc. (kg Qox/m3)	0.540	0.540
$COD_{loss\ chem\ ox}$ (kg COD/kg Qox)	0.651	0.651
$M_{lagoon\_chemical\_ox}$ (kg COD)	105,148	75,072

16. Results from 12, 13, 14 and 15 are used to determine how much organic matter is lost anaerobically in the lagoon system. The aerobic reduction combined with the chemical oxidation and deposition of COD account for a higher value as compared to the quantity entering lagoon system. Thereby, the emissions from lagoon system shall be zero.

Formula 3 (project)	2008	2009
$\mathbf{M}_{lagoon\_total}$ (kg COD)	735,538	394,744
$M_{lagoon\_aerobic}$ (kg COD)	1,419,850	530,845
$M_{lagoon\_chemical\_ox}$ (kg COD)	105,148	213,553
$M_{lagoon\_deposition}$ (kg COD)	52,432	28,139
$M_{\mathbf{lagoon\_anaerobic}}$ **(kg COD)**	-	-

17. The result from 16 is used to determine the project emissions using an emission factor for methane from COD (fixed at 0.21kg CH4/kg COD) and multiplying with 21 (GWP potential of methane)

Formula 2 (project)	2008	2009
$\mathbf{M}_{lagoon\_anaerobic}$ (kg COD)	0.00	0.00
EF_{CH4} (kg CH_4/kg COD)	0.210	0.210
GWP_{CH4} (tCO_2e/tCH_4)	21	21
$E_{\mathbf{CH4\_lagoons}}$ **(tCO_2e)**	-	-

18. Percentage of methane in gas is monitored on minute by minute basis and daily average is used in log records. Before the availability of gas analyzer, no methane percentage record is available. Thereby for the time period (25th May 2008 to 24th Sep 2008) when no value is monitored a conservative value is used based on the 99% confidence interval for the methane values. The 99% confidence interval for the remaining monitoring period (after 24th Sep 2008) is compared with 99% confidence interval of the val-

ues for the same period in the following year (25th May 2009 to 24th Sep 2009 - after monitoring period). The lower value out of the two intervals is used for estimation of baseline emissions and the higher value out of the two intervals is used for project emissions. The approach is explained in detail in Deviation 1, Annex 2.

The lower value of 99% confidence interval is used for estimation of baseline emissions and for the estimation of the project emissions, the higher value of the 99% confidence interval is used.

19. The combustion efficiency (Efficiency of fuel burning) of the boiler shall be measured through on site tests and is used to determine the methane emissions due to inefficient combustion. One minus the efficiency multiplied by the amount of biogas sent to boilers and average methane percentage gives the un-burnt amount of methane volume escaping the biogas boiler. Methane density (default at 0.716kg/Nm3) is used to determine the amount of methane in tones. The value multiplied by GWP of methane (21) gives the project emissions.

$$E_{CH4\_IC\,|\,Leaks} = (\sum_{r} V_r \cdot C_{CH4\_r} \cdot (1 - f_r) \cdot GWP_{CH4}) + PE_{flare}$$

	2008	2009
Methane Percentage	64.56%	67.35%
V_{heat} (Nm^3)	1,250,532	584,280
f_{heat} (%)	98.5%	98.5%
GWP_{CH4} (tCO_2e/tCH_4)	21	21
$\rho_{CH4,n}$ (kg/Nm^3)	0.716	0.716
$E_{CH4\_IC\_heat}$ (tCO_2e)	**183.3**	**88.7**

During this monitoring period, no measurement of the combustion efficiency of the boiler was carried out. The test report from a test done on 31st October 2009, for the exhaust gas analysis provides the percentage of un-burnt hydrocarbon in the exhaust gas.

The result from the report is 3.37 ppm at actual oxygen levels

3.37 ppm = 3.37 in 1,000,000 units = 0.00000337

(1/100) x 0.00000337 = 0.000337% of non-combustion

Therefore, the combustion efficiency is 99.999663%.

The ex-ante value of the PDD (98.5%) being lower than the test report value results in higher project emissions. The PDD value is thus used for conservativeness[9]. Please refer to Deviation 2, Annex 2 for more details.

The daily methane percentage is used to estimate the project emissions from the combustion of biogas in the boiler. For the time period (25th May 2008 to 24th Sep 2008) when no value is monitored a conservative value is used based on Deviation 1, Annex 2.

The methane percentage values used for the time period of non-availability of methane (25th May to 24th Sep 2008) data is as follows:

[9] The test report is not available for the monitoring period. However a test on later date is available, and the value used for project emissions is on conservative side. Please refer to Deviation 2 in the Annex 2.

Methane Percentage	For BE	For PE
	62.718%	66.349%

In the calculation table on previous page the values represented for the 2008 only refers to the average value for the time period when the actual readings are available. The representation in the following table has no influence on the actual calculations as the calculations are based on daily values.

20. The combustion efficiency (Efficiency of fuel burning) of the gas engine shall be measured through on site testing and is used to determine the methane emissions due to inefficient combustion in gas engine. One minus the efficiency multiplied by the amount of biogas sent to gas engines and average methane percentage gives the un-burnt amount of methane volume escaping the gas engine. Methane density (default at 0.716kg/Nm3) is used to determine the amount of methane in tonnes for monitoring period. The value multiplied by GWP of methane (21) gives the project emissions for inefficient burning in gas engines.

	2008	**2009**
V_{elec} (Nm^3)	279,133	439,603
f_{elec} (%)	99%	99%
Methane Percentage	64.56%	67.35%
GWP_{CH4} (tCO_2e/tCH_4)	21	21
$p_{CH4,n}$ (kg/Nm^3)	0.716	0.716
$E_{CH4\_IC\_elec}$ (tCO2e)	**26.7**	**44.4**

During this monitoring period, no measurement of the combustion efficiency of the gas engine was carried out. The test report from test done on 31st October 2009 for the exhaust gas analysis provides the percentage of un burnt hydrocarbon in the exhaust gas. This test was performed after the monitoring period on 31st October 2009.

The result of combustion efficiency from the report is 0.05 ppm at actual oxygen levels
0.05 ppm = 0.05 in 1,000,000 unit = 0.00000005
(1/100) x 0.00000005 = 0.000005% of non-combustion
Therefore, the combustion efficiency is 99.999995%.

The ex-ante value of the PDD (99%) being lower than the test report value results in higher project emissions. The PDD value is thus used for conservativeness [10]. Refer to Deviation 2, Annex 2.

The daily methane percentage is used to estimate the project emissions from the combustion of biogas in the gas engine. For the time period (25th May 2008 to 24th Sep 2008) when no value is monitored a conservative value is used based on Deviation 1, Annex 2.

The methane percentage values used for the time period of non-availability of methane (25th May to 24th Sep 2008) data is as follows:

Methane Percentage	For BE	For PE
	62.718%	66.349%

[10] The test report is not available for the monitoring period. However a test on later date is available, and the value used for project emissions is on conservative side. Please refer to Deviation 2 in the Annex 2.

In the previous calculation table the values represented for the 2008 only refers to the average value for the time period when the actual readings are available. The representation in the following table has no influence on the actual calculations as the calculations are based on daily values.

21. The flare efficiency is fixed at 50%. The flare detection signal is recorded via an automated system, which is integral part of flare system. The csv format files are analyzed to ensure that flare is operational at all times when gas goes to flare system. The system operates on automatic logic which ensures flare operation at times, and stops the gas supply to flare in case flame is not detected by the system.
22. The biogas sent to flare is used to estimate flare emission on a daily basis. The flared biogas is multiplied with the methane percentage and density of methane to estimate methane combusted. The flare efficiency of 50% on daily basis is established on the basis of minute to minute flame detection record available in SCADA output files.
23. Using the flame signal the efficiency of the flare is established on daily basis. The time of gas going to flare and the flame detection signal cannot be compared on daily basis, to establish that flame is detected when the biogas goes to the flare system. The calculation is included in the excel sheet and is used to estimate the flare emissions. A GWP of 21 is used for methane. For details on the methane percentage data please refer also to Deviation 1 in Annex 2.

The methane percentage values used for the time period of non-availability of methane (25^{th} May to 24^{th} Sep 2008) data is as follows:

Methane Percentage	For BE	For PE
	62.718%	66.349%

In the following calculation table the values represented for the 2008 only refers to the average value for the time period when the actual readings are available. The representation in the following table has no influence on the actual calculations as the calculations are based on daily values.

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

Biogas sent to flare V_1 (Nm^3)	**2053824**	**505170**
Methane Percentage	64.56%	67.35%
$ή_{flare,h}$ (%)	50.0%	50.0%
GWP_{CH4} (tCO_2e/tCH_4)	21.00	21.00
PE_{flare} **(tCO_2e)**	**10,121**	**2,554**

24. The value from result 7 is used to estimate the Emission due to leakages etc.

$$E_{CH4\_NAWTF} = (E_{CH4\_lagoon\_BL} - E_{CH4\_lagoon}) \times F_{leakage\_NAWTF} = (E_{CH4\_lagoon\_BL} - E_{CH4\_lagoon}) \times 0.01$$

	2008	2009
$E_{CH4\_lagoons\_BL}$ (tCO_2e)	14,099	9,841
$E_{CH4\_lagoons}$ (tCO_2e)	0	0
$F_{CH4\_leakage\_NAWTF}$ (%)	1.0%	1.0%
E_{CH4_NAWTF} (tCO_2e)	**141**	**98**

25. The overall project emissions from inefficient burning of biogas in boiler, gas engine and flaring is estimated from 17, 19, 20, 23 and 24.

Formula 1	2008	2009
$E_{CH4\_lagoons}$ (tCO_2e)	0	0
E_{CH4_NAWTF} (tCO_2e)	141	98
$E_{CH4\_IC+Leaks}$ (tCO_2e)	10331	2687
$E_{project}$ (tCO_2e)	10,472	2,786

C) Emission reductions

26. Result from 25 is deducted from 10 to get over all emission reductions.

	2008	2009
$ER_{conservative}$ (tCO_2e)	5,976	8,681
ER (tCO_2e)	5,976	8,681
Conservativeness estimate	-20,484	-5,715

Overall conservativeness is assured by comparing the emission reduction calculated above with approach using the biogas captured and used.

27. Default methane density and global warming potential of methane is used to estimate the amount of methane avoided by the capturing facility.
28. The daily biogas volumes consumed in boiler, flare and gas engine are multiplied by the daily methane content value and remaining constants and summed up to determine the emission reductions from direct methane capture and destruction. For the time period (25th May 2008 to 24th Sep 2008) when no value is monitored a conservative value is used based on Deviation 1, Annex 2.

The methane percentage values used for the time period of non-availability of methane (25^{th} May to 24^{th} Sep 2008) data is as follows:

Methane Percentage	For BE	For PE
	62.718%	66.349%

In the following calculation table the values represented for the 2008 only refers to the average value for the time period when the actual readings are available. The representation in the following table has no influence on the actual calculations as the calculations are based on daily values.

E_{CH4_Coll} (tCO2e)	**34442**	**15458**
V_{Biogas} (combusted) Nm3	3,583,489	1,529,053
Methane % in biogas	64.56%	67.35%
$\rho_{CH4,\ n}$ (kg/Nm3)	0.72	0.72
GWP - Methane	21	21

29. The results from 28 and 26 are compared to establish that the approach used is conservative.

Formula 13	**2008**	**2009**
=	-20,484	-5,715
$E_{CH4\_lagoon\_BL}$ (tCO_2e)	14,099	9,841
E_{CH4_lagoon} (tCO_2e)	0.00	0.00
E_{CH4_NAWTF} (tCO_2e)	141	98
E_{CH4_Coll} (tCO_2e)	34,442	15,458

The above comparison suggests that result estimated in 26 is correct and conservative.

Year (Vintage)	**2008**	**2009**
Emission Reductions	5976	8681

The total Emission Reductions for the period of monitoring report is **14,657 tCO_2e**.

Annex 1. Gold Standard Monitoring Parameters

The Sustainable Development Matrix for the project activity is provided in the Gold Standard Annex submitted at the time of GS registration.

The Sustainable Development Assessment Matrix shows that several indicators are crucial, either because they strongly contribute to an overall positive score and/or because they were specifically pointed out by stakeholders during the consultation process.

The crucial indicators are thus examined in the tables below.

It should be noted that there is no indicator with a negative score and there is no sensitive indicator, which changed during the monitoring period.

No	1
Indicator	Air quality: *Odour from the wastewater treatment plant*
Chosen parameter	Volume of biogas production and combustion (Nm^3)
Monitored Value	2008 (25 May - 31 Dec): 3,583,489 Nm^3 (Biogas Combusted) 2009 (1 Jan – 24 March): 1,529,053 Nm^3 (Biogas Combusted) The odor is reduced as a result of the project activity, since the new system is a closed system and the biogas produced is utilized for electricity and heat generation. Any gases that would lead to odor emissions (mainly H_2S and other sulphur compounds) are captured with the biogas and either destroyed in the boilers or removed in the desulphurization system (gas scrubber) prior to reaching the engine, without release of odour emissions to the atmosphere. Given this fact, monitoring of biogas production and utilization is sufficient to demonstrate a reduction in odor emissions from the project. The gas when not used for useful purposes is flared and avoids any kind of the odour emissions to atmosphere. The automatic flare system ensures the combustion.
Monitored Frequency	Measured continuously by gas flow meters at the reactor outlet and at the inlet of the boiler, engine / generator set and flare system. The plant operator is responsible for recoding the monitoring values. The biogas quantity consumed is continuously monitored as part of CDM monitoring procedures.
Relation to Monitoring Plan parameter if any	AM0022 ID 5 – Volume of biogas sent to facility heater AM0022 ID 9 – Volume of biogas sent to flare AM0022 ID 10 – Volume of biogas sent to generation
Monitoring Results and Conclusions	The daily records of the biogas consumption are available in calculation sheet. These are accumulated on yearly basis and the results are presented as above. The combusted biogas volumes ensure that no odor from

	waste water results as the biogas generated is combusted in boiler / gas engines or flares. The parameter doesn't change from the conditions as compared to validation stage; thereby the score for this indicator is not affected. Hence it is concluded that GS qualification of the project is not affected in perspective of this sustainability indicator.

No	2
Indicator	Employment (numbers)
Chosen parameter	Number of employed staffs and the level of income generation
Monitored Value	During the monitoring period, at least 9 staff is employed during a particular month. During some months up to 12 staff is employed at CYY Bio Power Co. Ltd. The following is the composition of the employees for the year 2008 and 2009, respectively.. <table><tr><td></td><td>2008</td><td>2009</td></tr><tr><td>Head of quality Control</td><td>1</td><td>1</td></tr><tr><td>Biogas systems controllers</td><td>3</td><td>4</td></tr><tr><td>Power system controllers</td><td>0</td><td>2</td></tr><tr><td>Quality Control</td><td>10</td><td>6</td></tr></table> The records of the payments made to the employees are available as a separate document.
Monitored Frequency	The record of employees staffed and payments made are recorded on monthly basis.
Relation to Monitoring Plan parameter if any	NA
Monitoring Results and Conclusions	The project activity has provided the employment to the local people as temporary and permanent jobs, This is the positive socio-economic benefit affected by the project activity for the local region. The payment details to employees are provided as separate documents for confidential reasons. The parameter doesn't change from the conditions as compared to validation stage; thereby the score for this indicator is not affected. Hence it is concluded that GS qualification of the project is not affected in perspective of this sustainability indicator.

Data / Parameter:	Monitoring of sludge application
Data unit:	Amount of sludge removed and type of application
Description:	Removal and application of sludge leaving the reactor.
Source of data to be used:	Plant records i.e. using weigh bridge records.
Value of data applied for the purpose of calculating expected emission reductions	No sludge is removed during the monitoring period.
Description of measurement methods and procedures to be applied:	Log book records of any vehicles including weight and destination.
QA/QC procedures to be applied:	For any sludge removed and sent out, the record in log book shall be checked on regular basis by plant manager.
Any comment:	No event is recorded in the monitoring period for sludge removal from the anaerobic digester.

Consideration of 65% biogas usage threshold for energy utilization for biogas projects:

Parameter	**2008 (25 May – 31 Dec)**	**2009 (1 Jan – 24 Mar)**

Biogas consumed in boiler	1,250,532 Nm^3	584,280 Nm^3
Biogas consumed in gas engines	279,133 Nm^3	439,603 Nm^3
Biogas flared	2,053,824 Nm^3	505,170 Nm^3
Total biogas consumed	3,583,489 Nm^3	1,529,053 Nm^3
% of biogas for gainful use	42.7%	67%

For 2008 monitoring period represents the initial phase of the project, as the project implementation is not complete until 29th Nov 2008 (date of commissioning of gas engine). Thereby a lot of biogas is flared during the year 2008 and the amount of biogas used for energy purposes is at 42.7%. In 2008 itself before the commissioning of gas engine, the gas usage at different locations is, boiler – 34%, flare – 66%. After the commissioning of gas engine in 2008 the biogas usage percentages are boiler – 38%, gas engine – 36% and flare – 26%. In 2009 most of the biogas is used for generation of thermal energy and electricity. In 2009 both the gas engines were operational but still faced some technical problems. A 67% biogas usage is achieved for energy purposes out of total biogas generated, which satisfies the threshold criteria. The situation is expected to improve in the following year and project proponent would use most of the biogas for the purpose of generation of thermal energy or electricity.

In addition to the above monitoring plan, regular CDM monitoring procedures as specified in the PDD of the project activity account for:

- Determination of project emissions and emission reductions during the crediting period
- Determination of monitoring method (including data registration, monitoring, measurement and calibration) and the equipment applied
- Quality assurance and control procedures for the monitoring process
- Documentation of all relevant monitoring steps

The data related to the social, environmental and economic indicators shall be archived for a period of 2 years after the end of the crediting period.

The project has an overall positive impact in terms of socio-economic impact on the nearby areas and communities.

Conclusion:
It can be suitably established that the project complies with the Monitoring Plan laid out in the Gold Standard Annex; hence, the **14,657 VERs** under the monitoring period under consideration are eligible for issuance under Gold Standard.

Annex 2. Deviations in the Monitoring Report

Deviation	Approach in registered PDD	Change in Monitoring Plan	Justification of conservativeness.
1	Methane percentage in the biogas shall be monitored continuously using the online methane analyzer.	For the period prior to the installation of the continuous methane analyzer, the methane percentage is determined by establishing 99% confidence interval for the available data, for the remaining monitoring period.	Before the installation of the continuous methane analyzer, the values of methane percentage are not available. After the installation of continuous analyzer, the methane percentage values are available on continuous basis. Since no configuration and operation changes happen to project activity when the methane analyzer is installed. This implies that average methane percentage can be represented as a range of data at specific confidence and precision level[11]. The available data after the methane analyzer installation is used to determine conservative value of methane percentage for the period when no data is available. For year 2008, there is no data available for time period 25th May to 24th September. The methane percentage values are available for time period 25th September 2008 to 24th March 2009. To establish 99% confidence interval is established for two sets of data i.e. remaining part of monitoring period for which data us available (25th September 2008 to 24th March 2009) and the equivalent period in the following year (25th May to 24th September 2009) during which data is not available in 2008 . If the methane percentage figures are plotted for the year 2009 on the graph[12], we see that the distribution has no clear trend and may not only dependent on time of the year but many other factors also. The measurement thereby is regarded as a random sample and large sample size of such readings would represent a normal distribution. In

[11] http://cdm.unfccc.int/EB/050/eb50_repan30.pdf The approach of defining a confidence interval and estimating the precision level is in line with the EB guideline.

[12] Graph in excel calculation sheet.

			probability and statistics, Student's t-distribution (or simply the t-distribution) is a continuous probability distribution that arises when estimating the mean of a normally distributed population in situations where the sample size is small. The student-t distribution approach is followed[13]. The excel sheet contains the estimation of confidence interval as per the approach described below. From the two confidence intervals established, the lower of the two values is used for estimating baseline emissions and higher value is used for estimating project emissions.
2	Combustion efficiency of gas engine and the boiler are not monitored during the monitoring period.	The project proponent has not monitored the efficiencies during the monitoring period and thereby applied the ex-ante assumed values to estimate the emission reductions.	Since the start of the project activity there has been no change in the equipments in the project activity. The efficiency of combustion of biogas in the boiler and project activity is monitored after this monitoring period. The results obtained from combustion efficiency tests demonstrate that the ex-ante value of the combustion efficiency is more conservative values for both boiler and gas engine. Thereby, the ex-ante values used in PDD result in higher project emissions as compared to the measured values from test results.
3	The bypass waste water to the lagoon system to be monitored.	Not monitored in actual monitoring plan.	The parameter has no effect on baseline and project emissions of project activity. The respective revision to the CDM monitoring plan is already approved by UNFCCC[14].
4	The colorimeter shall be regularly tested in line with the registered PDD.	Not tested during the monitoring period.	The COD_{in} and COD_{out} (total readings) for the 2008 and 2009 readings are adjusted for the error equal to accuracy of the colorimeter. The COD_{in} load is adjusted by an error of 1/420 towards lower side and the COD_{out} load is adjusted towards positive side.

Further explanations related to Deviation 1: **Status in the monitoring / monitoring period:** For year 2008, there is no data available for time period 25th May to 24th September. The methane percentage values are available for time period 25th September 2008 to 24th March 2009 (during the monitoring period). In the year after the monitoring period, the data for methane percentage is available for the complete year.

[13] In case there are infinite number of data samples available, true mean and true standard deviation can be established for the normally distributed data. On the other hand when number of samples is low, Student-t distribution approach is used (see also http://en.wikipedia.org/wiki/Student's_t-distribution). The calculation approach from student t distribution is explained after this table.

[14] For revised monitoring plan: http://cdm.unfccc.int/Projects/DB/RWTUV1218617500.62/view

Introduction to followed approach: If the methane percentage figures are plotted for the year 2009 on the graph[15], we see that the distribution has no clear trend and may not only dependent on time of the year but many other factors also. The measurement thereby is regarded as a random sample and large sample size of such readings would represent a normal distribution.

In probability and statistics, Student's t-distribution (or simply the t-distribution) is a continuous probability distribution that arises when estimating the mean of a normally distributed population in situations where the sample size is small. (http://en.wikipedia.org/wiki/Student's_t-distribution)

Approach used: 99% confidence interval is established for the time period 25th September 2008 to 24th March 2009 (which is a part of monitoring period). Another 99% confidence interval is established for time period 25th May 2009 to 24th September 2009, which corresponds to the equivalent period in the following year during which data is not available in 2008 (please note that the factory is not operational for some part of these months)

The two confidence intervals are compared for upper and lower limits. The smaller value of the two lower limits is used for the baseline emissions and the higher of the two upper limits is used for the project emissions. These values are used on day to day basis, for the days when no methane measurement data was available. The theory of the Student-t distribution is explained as follows.

Student – t Distribution approach to establish 99% confidence interval for methane percentage

$\bar{X}$= Average of the n number of sample readings available.

μ= is the mean of normally distributed data if large number of readings are available.

s= standard deviation of the sample readings.

n=number of sample readings

n-1 = degrees of freedom, the scores which are free to vary.

A = Factor applied to the calculation term based on standard tables, the value of A is inversely proportional to the value of n. If more number of samples is available, the value of A is lower, whereby the range of confidence interval is low making the estimate more precise. For the reference check the references below.

These standard tables are also called critical value tables for the student-t distribution. In these tables the degrees of freedom (usually in the first column) is determined from the value 'n-1'. If the exact value for 'n-1' is not available in the first column then the closest lower value is chosen. Going further the column headings denote value of α. For 99% confidence interval, we look for value in the column with α = 0.005 and in row closest (lower) value to the 'n-1'. Here n is the number of samples available. This value represents the value of A which can be used in the formula below.

In such cases the confidence intervals is defined, in which the value μ would lie with a probability of (100-α)%. So in this case we select α =0.005%, the interval is defined as $[\bar{X} - \left(A * \right.$ $sn, X+ \; A* sn$]. Here A is dependent on the number of sample readings available. The value is available in standard tables on many sources.

More specifically, probability ($\bar{X} - \left(A * {}^{s}/_{\sqrt{n}} \right) \leq \mu \leq \bar{X} + \left(A * {}^{s}/_{\sqrt{n}} \right)$) = 0.99

[15] Graph in excel calculation sheet.

The higher limit of above interval is used for estimation of project emissions, and lower limit is used for estimation of baseline emissions. However, the methane percentage has no affect on the baseline emissions as the COD loading approach is more conservative.

Sources:

Student-t distribution theory: http://www.wikidoc.org/index.php/Student's_t-distribution
Confidence Interval theory: http://www.wikidoc.org/index.php/Confidence_interval
'A' values for variable probabilities:
http://www.staff.brad.ac.uk/yysentur/course/dp1008m/Student-t-table.pdf
Distribution Tables: http://www.statsoft.com/textbook/distribution-tables/
Statistic Tutorials: http://stattrek.com/Lesson3/TDistribution.aspx?Tutorial=AP