MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01 - 31/10/2010

Chumporn applied biogas technology for advanced waste water management.
UNFCCC Ref. No. 2148
1st monitoring period (09/02/2009 - 31/08/2010)

SECTION A. General description of the project activity

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

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This section is a brief summary of the detailed description given in the section "B.1 Implementation status of the project activity"

1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions
The purpose of the Chumporn applied biogas technology for advanced waste water management is to treat the wastewater generated in the production of palm oil and to use the organic matter removed from the wastewater to produce heat from clean, renewable energy (biogas). The project activity consists of a wastewater treatment facility, i.e. two anaerobic tank digesters, as well as a combustion system to generate heat from the produced biogas. Biogas is produced by the anaerobic digestion of organic matter in the tank reactors. The project activity involves the design, construction, installation, start-up and operation of the wastewater treatment and heat generation facilities.

Hence, the project lead to a shift from traditional waste water treatment in open, anaerobic ponds with uncontrolled release of methane to the atmosphere to a closed tank digester system with biogas capture and utilization. The ultimate purpose of the project activity is to reduce greenhouse gas emissions to the atmosphere and contribute to an environmentally and socially sustainable development of palm oil production at Chumporn Palm Oil Industry (CPI).

2. Brief description of the installed technology and equipments

A modern waste water treatment technology was implemented at CPI. The existing simple wastewater treatment system in open, anaerobic lagoons has been replaced by a closed tank digester system to recover methane and produce biogas. The latter will be utilized in the production process at CPI to generate heat.

The building and operation of a **completely stirred tank reactor (CSTR)** is the central part of the project activity. Two tank reactors with a utilizable volume of 6,000 m^3 are to be established and operated. This allows a maximum daily load of approx. 800 m^3 waste water. The recent output of the plant has typically been 475 - 650 m^3/day. Based on this, the system is expected produce approximately 12,700 m^3 of biogas per day, which will substitute the utilization of heavy oil and of palm shells for heat generation.

3. Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)

Construction of the project began in February 2006
Commissioning and testing of the project began in March 2007
Project had started its operation from May 2007
Full operation since July 2007
Project was registered on 09.February 2009

4. Total emission reductions achieved in this monitoring period.

Monitoring period: 09 February 2009 to 31 August 2010
Number of days during this monitoring period: 569 Days
Total Emission Reduction achieved during this monitoring period: **41,177 tCO_2e**

A.2. Project Participants

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Name of Party involved (*) **((host) indicates a host Party)**	**Private and/or public entity(ies) project participants (*)** **(as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant** **(Yes/No)**
Germany	Private entity: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, Germany	No
Thailand (host)	Private entity: Chumporn Palm Oil Public Company Limited, Bangkok, Thailand	No

Germany has ratified the Kyoto Protocol on 31/05/02
Thailand has ratified the Kyoto Protocol on 28/08/02

A.3. Location of the project activity:

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CPI is located in Chumporn province in the uppermost part of the Southern region. The Gulf of Thailand is in the east, while the Union of Myanmar is in the west. The location is approximately 463 km south-south-west from Bangkok, close to the Tha Sae intersection about 15 km north of Chumporn City. The project activity is located within the existing site of the Chumporn Palm Oil Industry Complex; therefore no additional area is required.

The address of the factory of CPI is:
296, Moo 2 Phetchkasem Road, Tambol Salui, Ampur Tasae, Chumporn, Thailand 86140.

The geographical co-ordinates are N 10’38, E 99°10’9.

Fig. 1 visualizes the physical location of the project activity in Thailand.

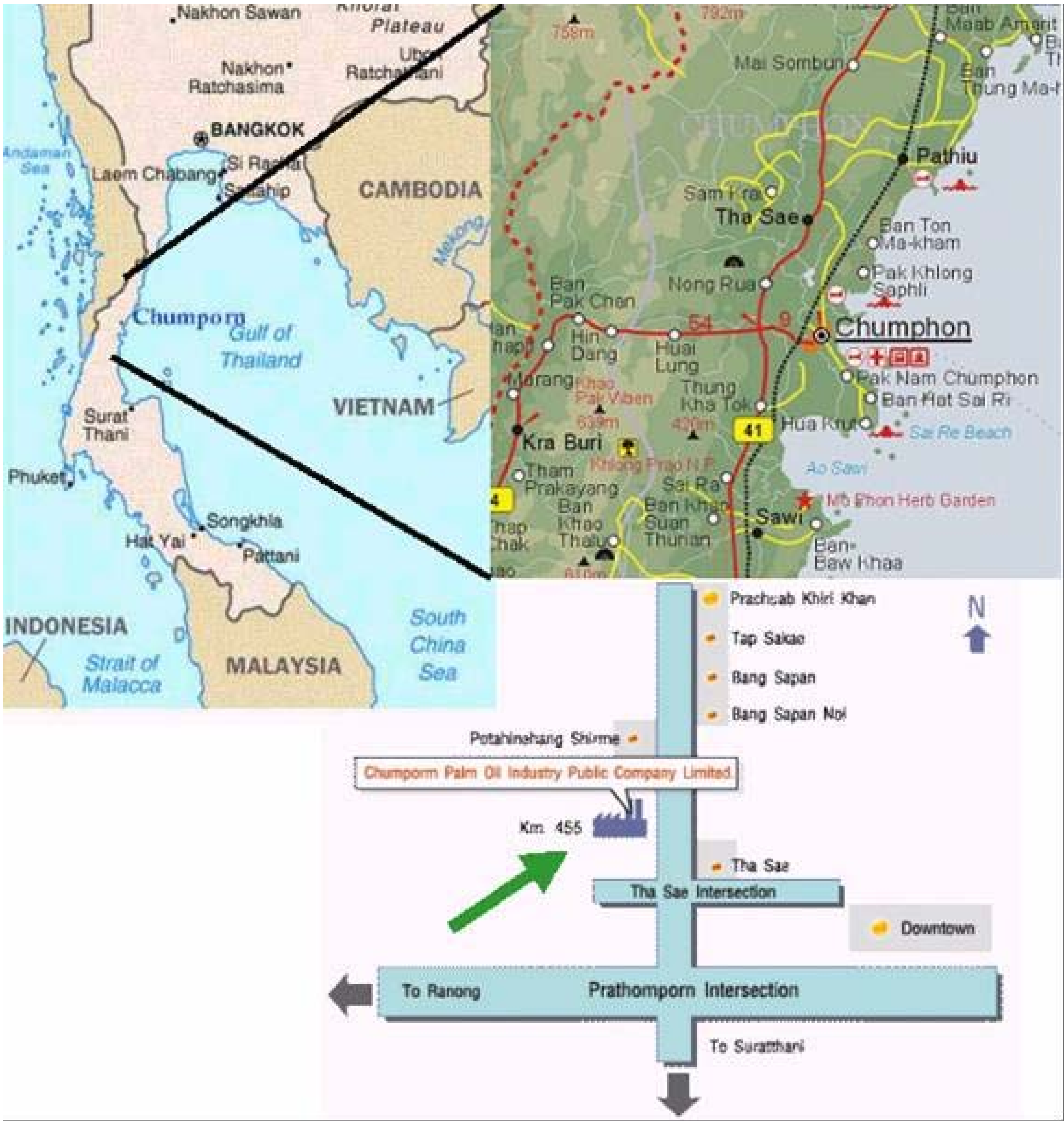

Fig. 1: Map of physical location of the project activity in Thailand.

A.4. Technical description of the project

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A modern waste water treatment technology was implemented at CPI. Waste water generated through palm oil processing averages 0.5 m^3/ton of fresh fruit bunches (FFB). The palm oil mill processes about 260,000 – 320,000 t FFB and thus 130,000 – 160,000 m^3 wastewater per year, with an average of approximately 145,000 m^3/year. The existing simple wastewater treatment system in open, anaerobic lagoons has been replaced by a closed tank digester system to recover methane and produce biogas. The latter is utilized in the production process at CPI to generate heat.

The discharge of the plant is characterized by a high chemical oxygen demand (COD) stemming from organic fractions of the palm oil production process, primarily FFB. Laboratory tests showed that discharged effluent has a COD of approximately 70-100 g/liter of which about 70%-80% is biodegradable. The building and operation of a **completely stirred tank reactor (CSTR)** is the central part of the project activity. A CSTR-system has been chosen as it is best suited for the underlying situation. Since the waste water is characterized not only by a high COD, but also by a high load of suspended solids (SS) with low separation ability, an adoption of traditional tank reactors to the specific site characteristics is necessary. Thus, an ***Appropriate Complete Stirred Tank Reactor*** **(A-CSTR)** will

be established, which has been developed in co-operation between Thai experts and the University of Wageningen, Netherlands; the equipment itself will be delivered by a Thai company5. The design engineering of the A-CSTR optimizes the contact rate of bacteria with effluent while minimizing energy needed for mixing purposes. Two tank reactors with a utilizable volume of 6,000 m^3 are to be established and operated. This will allow a maximum daily load of approx. 800 m^3 waste water. The recent output of the plant has typically been 475 - 650 m^3/day. Based on this, the system is expected produce approximately 12,700 m^3 of biogas per day, which will substitute the utilization of heavy oil and of palm shells for heat generation.
The two tank reactors will be composed of reinforced concrete in a half capsule channel shape that is partly underground. An outlet pipe will be installed at the bottom of hopper shapes in the tank to drain digested sludge to the sand bed filter. An overflow system allows the discharge of digested effluent with low COD and SS content. COD content in the effluent will be reduced by about 80% and enter the conventional open-pond post treatment process. Thus, the project activity will not only reduce GHG emissions, but also enhance the quality of effluent from the palm oil plant through a significant reduction of COD. The digested effluent will be used for irrigation purposes at surrounding palm plantations. The A-CSTR system ensures a continuous high contact rate of bacteria in the reactor. Produced biogas gas will be re-circulated into the digester for mixing purposes. The top of the digester is equipped with a plastic sheet system to collect all the generated biogas to be stored and utilized as a renewable energy source.

Besides the tank reactor, being the central element of the improved treatment process, the following components were installed:

- Collection and equalization tank
  The tank allows temperature adjustment of waste water leaving the production process as well as a first sedimentation of solid components0
- Screening and sand trap
  The effluent from the collection/equalization tank will be pumped to a screening device for removing large particles and sand from the wastewater before entering A-CSTR.
- Distribution Tank
  The distribution tank continuously pumps screened effluent to A-CSTR.
- Sand Bed Filter
  Separation of solid and liquid parts of digested sludge from the bottom of the digester.
- Post Treatment and storage pond
  Overflow effluent of the A-CSTR digester and effluent from the sand bed filter will be further treated in the existing open pond system.
- Biogas Filter
  Retained gas stored will first be channeled through a biogas filter in order to remove hydrogen sulfide (H2S).
- Combustion system
  The cleaned biogas will be utilized in the steam boilers to generate heat. Two boilers are operated: a mid/high pressure boiler (60-90 bar, boiler type NUK-HP 930, dual-fuel burner type RGMS7/1- D ZMD, DN50) and a low pressure boiler (30 bar, AWG Series II dual-fuel burner from Hamworthy (AWG 15)).

Plant operation will be monitored continuously. An open flare system will come into operation to deal with oversupply of methane or irregularities in the operation of the boilers. In such cases, the surplus of methane will be flared until the system operates regularly again.

The flow diagram in Fig. 2 summarizes the described process.

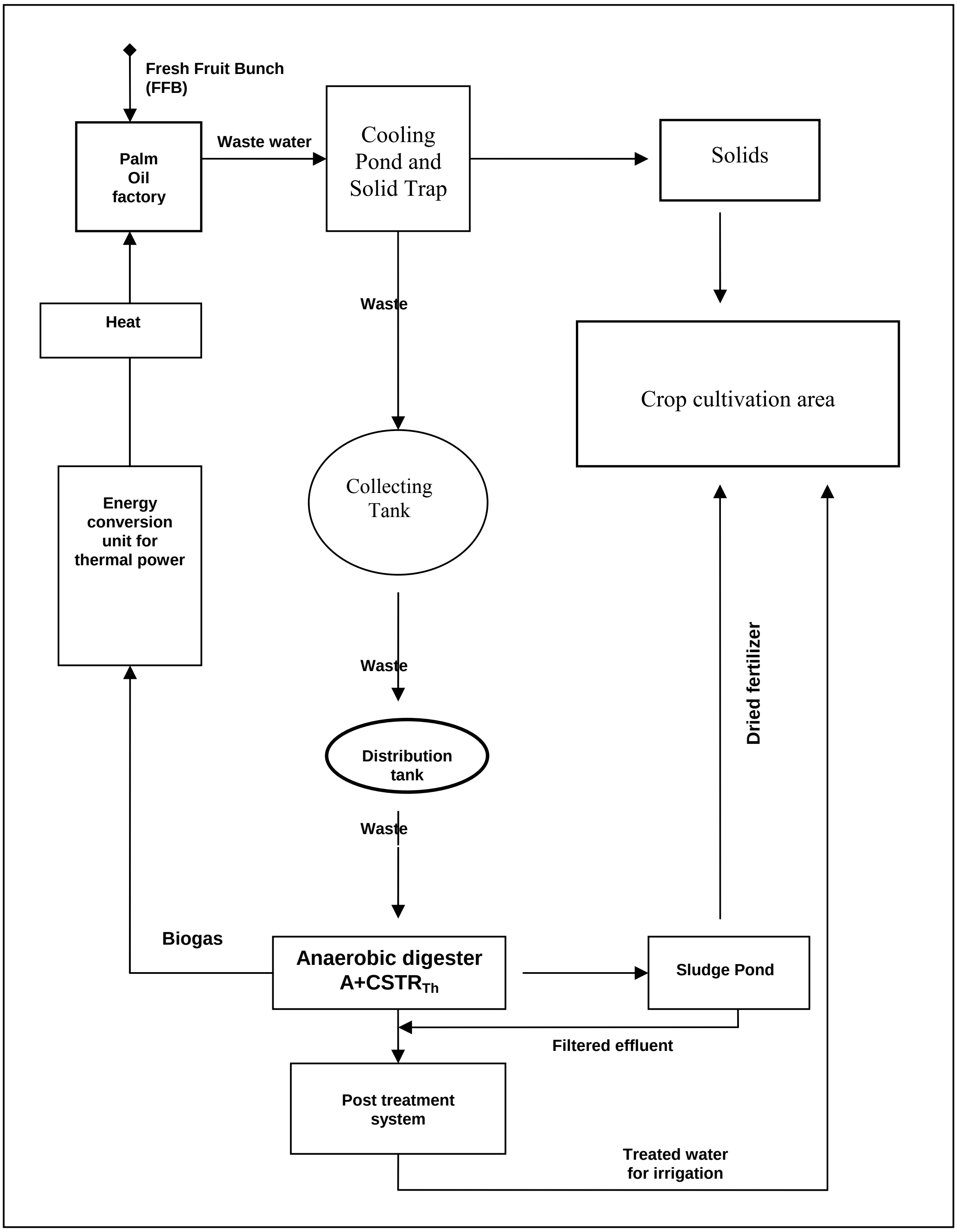

Fig. 2: Flow diagram of improved waste water management system.

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

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Approved Methodology AM0013 "Avoided methane emissions from organic waste-water treatment", version 4, as of December 22nd, 2006 is applied. This methodology is based on the baseline approach from paragraph 48 of the CDM modalities and procedures "Existing actual or historical emissions as applicable".

The calculation of the Thai grid emissions factor is based on the Approved Consolidated Methodology ACM002, version 6, as of May 19th, 2006 is applied.

The methodology also refers to the “Tool to determine project emissions from flaring gases containing Methane” (version as of December 2006) is applied. In addition, the “Tool for the demonstration and assessment of additionality” (version 03) is applied.

A.6. Registration date of the project activity:

>>
09/02/2009

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

>>
10 years

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

>>
The final draft of this CDM-MR was completed by:

Company name:	Pure Natural Power Co., Ltd.
Address:	110/6 Moo 5, Thambon Suthep, Amphoe Muang, Chiang Mai, Thailand
Contact person:	Mr. Jens Radschinski
Telephone number:	+66 (0)53 – 810 816
Fax number:	+66 (0)53 – 810 239
E-mail:	jr@pure-naturalpower.com info@pure-naturalpower.com

PURE Natural Power Co.,Ltd provides carbon advisory services for CDM projects and is not a project participant listed in Annex 1.

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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The project started in February 2006 by constructing the Anaerobic Digester System by Natural Power Co., Ltd. The construction period took 1 year and 1 month with the start of commissioning and testing in March 2007. The Project started up in May 2007 and came in to full operation in July 2007.
The monitoring of the CDM process started February 2009 with the registration of the project.
There were occasions of stoppages as a result of malfunction and maintenance, e.g. the replacement of the PVC cover foil in May 2010.

B.2. Revision of the monitoring plan

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The monitoring plan has not been revised.

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

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No deviation applies to this monitoring period.

B.4. Notification or request of approval of changes

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No approval of changes from the project activity as described in the registered CDM-PDD has been requested.

SECTION C. Description of the monitoring system

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The monitoring methodology AM0013 will be applied. This includes monitoring of a set of 33 parameters to determine baseline and project emissions. Since the project activity does not involve generation of electricity, the parameters 24 - 28 as listed in the monitoring methodology cannot be monitored. Fig. 3 summarizes the major monitoring points and data ID-numbers. Details for each ID-number are provided below (Table 1).

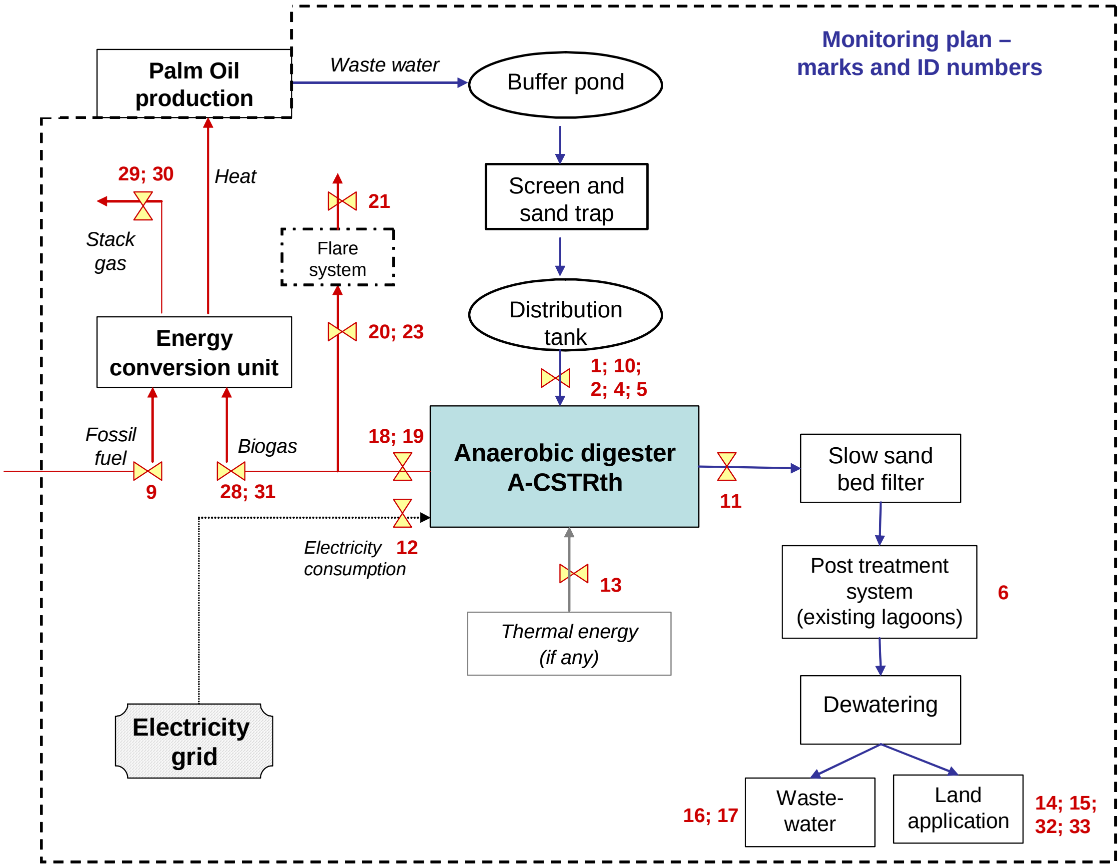

Fig. 3: Monitoring plan – overview of measurement points

Table 1: Monitoring Parameter

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
1, 10.	F_{Dig} = Flow rate of organic wastewater into the digester (F_{dig})	Nm^3 / yr	M	continuously	100%	Electronic, paper	Hourly values will be recorded. Use of flow meter
2	$COD_{c,baseline}$ = COD - concentration	kg COD/m^3	M	monthly	100%	electronic	Laboratory tests at CPI, Method AWWA 5220B.,P5-14,1998

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	of organic wastewater into the digester						
3	$COD_{a,out}$ = COD that leaves lagoon with the effluent	kg COD/yr	M	Historical 1 year data	100%	electronic	Laboratory tests at CPI, Method AWWA 5220B.,P5-14,1998
	B_o = maximum methane generating capacity	%	C	Ex-ante	100%		Ex-ante determination
4	$COD_{a,in}$=COD that enters the lagoon	kg COD/yr	M	Historical 1 year data	100%	electronic	Laboratory tests at CPI, Method AWWA 5220B.,P5-14,1998
5.	T_{lng} = Temperature of the lagoon	K	M	Daily (between 6:00 and 9:00 a.m.)	100%	Electronic, paper	Daily average is monitored but monthly average is used in the calculations.
6.	D_{lng} = Depth of lagoon	m	M	Monthly	100%	Electronic, paper	
7.	EG_y = amount of electricity that would be consumed in absence of project activity	MWh/yr	E	Ex-ante	100%		Not applicable because the project activity does not involve electricity generation.
	$CEF_{Blelec,y}$ = CO_2 emission factor for electricity consumed at the project site in the absence of the project activity	Kg CO_2/kWh	C	Ex-ante	100%	Electronic, paper	
8	$EG_{d,y}$ = amount of electricity generated utilizing the biogas.	kWh	M	n.a.	100%	Electronic	Not applicable because the project activity does not involve electricity generation.

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
9	$HG_{Bl,y}$ = quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel	MJ	m, c	Continuously	100%	Electronic, paper	Thermal energy consumed is determined from quantity of biogas consumed in the heat generation equipment and its calorific value: $HG_{Bl} = T_{comb,e}$ * FRe,inlet * NCVBG
	$CEF_{Bl,\ therm}$ = CO_2 emissions intensity for thermal energy generation		C	Ex-ante		Electronic, paper	Using standard emission factors
11	$COD_{c,dig\ out}$ = COD-concentration in discharged effluent from digester	Kg/m^3	M	Monthly	100%	Electronic, paper	Data used to estimate CH_4 emissions in the project case
12	$EL_{P,y}$ = amount of electricity in the year y that is consumed at the project site for the project activity	MWh/yr	M	Continuously	100%	Electronic, paper	
13	HGPr,y = quantity of thermal energy consumed from fossil fuels in year y at the project site due to the project activity	MJ, litres heavy oil	n.a.	n.a.	100%	Electronic, paper	Not applicable (no additional thermal energy consumption due to project activity)

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	$CEF_{Pr, therm,y}$ = CO_2 emissions intensity for thermal energy generation	Kg CO_2/MJ	n.a.	n.a.	100%	Electronic, paper	Not applicable (no additional thermal energy consumption due to project activity)
14	F_{la} = Quantity of sludge used for land application after dewatering	m^3/yr	M	Continuously	100%	Electronic, paper	Parameter monitored continuously but aggregated annually for calculations.
15.	$COD_{c,la}$ of the sludge used for land application after dewatering	kg COD/m^3	M	Monthly	100%	Electronic, paper	
16.	Fc,dw = flow rate of organic wastewater from the dewatering process	m^3/yr	M	n.a.	100%	Electronic, paper	No dewatering takes place
17.	$COD_{c,dw}$ of the wastewater from the dewatering process	kg COD/m^3	M	n.a.	100%	Electronic, paper	No dewatering takes place
18.	FR_{Bio} = biogas flow rate at digester outlet (two lines are considered)	Nm^3/yr	M	continuously	100%	electronic	Measure points (flow meters) at each digester line outlet. Hourly values will be recorded and aggregated annually.
19	$P_{CH4,bio}$ = biogas CH_4 content at digester outlet (measurements at each digester line)	ppm	M, c	Monthly	-	electronic	Average of 12 months will be recorded. CH_4 content will be determined through electronic probe and chemical analysis

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
20	FRf,inlet = biogas flow rate at flare inlet	Nm^3/yr	M	continuously	100%	electronic	Application of flow meters. Hourly values will be recorded and aggregated annually.
21	$FR_{f,s}$ = flow rate of the flare stack gases	Nm^3/yr	M	n.a.	100%	electronic	
22	PCH4,f,s = Methane content in stack gas of flare	ppm	M	n.a.	100%	electronic	
23	Tcomb,f = fraction of time gas is combusted in the flare	%	M	continuously	100%	electronic	Measured using a run time meter connected to a flame continuous temperature controller (Thermocouple transmitter 4-20mA). Signals of the transmitter are recorded and show run time of flare.
24	FRe,inlet = Flow rate of the biogas entering the electricity generation equipment	Nm^3/hr	M	n.a.	100%	electronic	Note: no electricity generation is involved. Instead, the flow rate of the biogas entering the heat generation equipment is monitored.
25	FRe, = Flow rate of the electricity generation equipment.			n.a.			Not applicable (see data # 24)
26	$P_{CH4,e,s}$ = methane content in stack gas of electricity generation stack gases.			n.a.			Not applicable (see data # 24)
27	$T_{comb,e}$ = fraction of time gas is combusted in the electricity generation	Hrs/yr	m	n.a.	100%	electronic	Not applicable (see data # 24)

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
	equipment.						
28	FRe,inlet = Flow rate of biogas entering the heat generation equipment.	Nm^3/yr	m	continuously	100%	electronic	Hourly values will be recorded and aggregated annually.
29	FRe,s = Flow rate of biogas of the heat generation equipment stack gases.	Nm^3/yr	m	continuously	100%	electronic	Hourly values will be recorded and aggregated annually.
30	$P_{CH4,e,s}$ = Methane content in stack gas of heat generation stack gases.	ppm	m	quarterly	100%	electronic	
31	$T_{comb,e}$ = Fraction of time gas is combusted in the heat generation equipment.	hrs/yr	m	Continuously	100%	electronic	Measured using a run time meter connected to a flame detector or a flame continuous temperature controller.
32	Sa = Amount of sludge applied to land	Kg/yr	m	Monthly	100%	Electronic, paper	
33	NC = Nitrogen content in the sludge	kg N/kg sludge	m	monthly	100%	electronic	Laboratory tests at CPI laboratory (Total Kjeldahl Nitrogen 3094 mg/L as N)
34	NCV_{BG} = Net calorific value biogas	TJ/m^3	m	weekly		Electronic	Laboratory tests at PTT Chemical Company Ltd. - Methane Method ASTM D 1945-91: analysis of total Hydrocarbons(C2-C5) – method ASTM D

ID Number(s)	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data to be monitored	How will data be archived? (electronic/ paper)	Comment
							2712-91

Organizational and management structures

The management structure as well as implementation and operation management of the efficient monitoring system will be as follows:

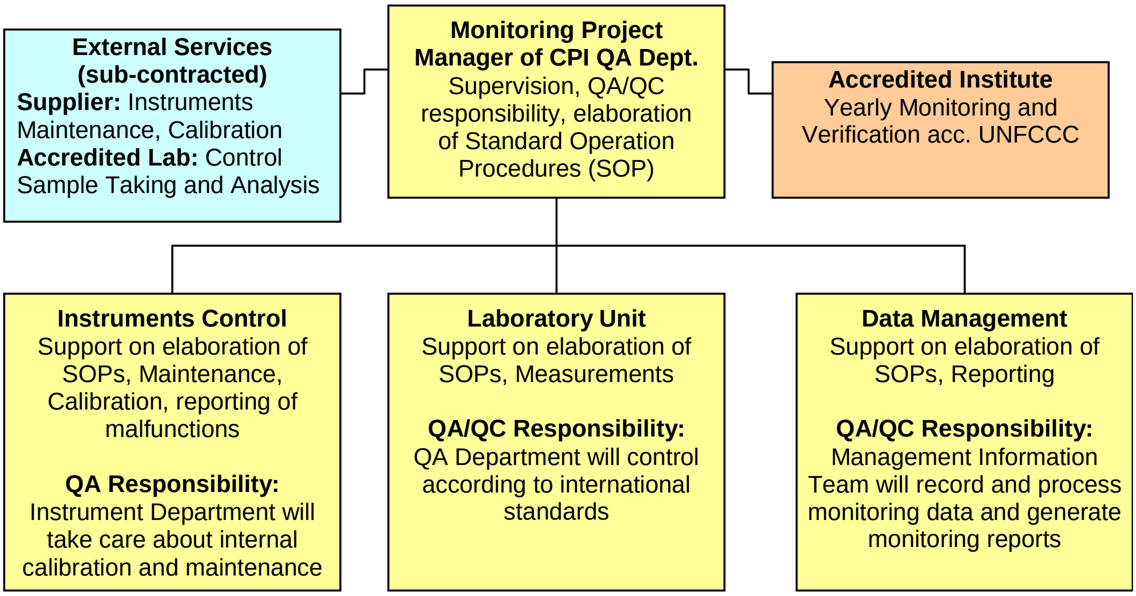

Fig. 4: Management Structure of Monitoring System

Monitoring implementation and operation management and procedure

In order to implement, operate, maintain and control the monitoring system appropriately, the following operation procedure will be implemented:

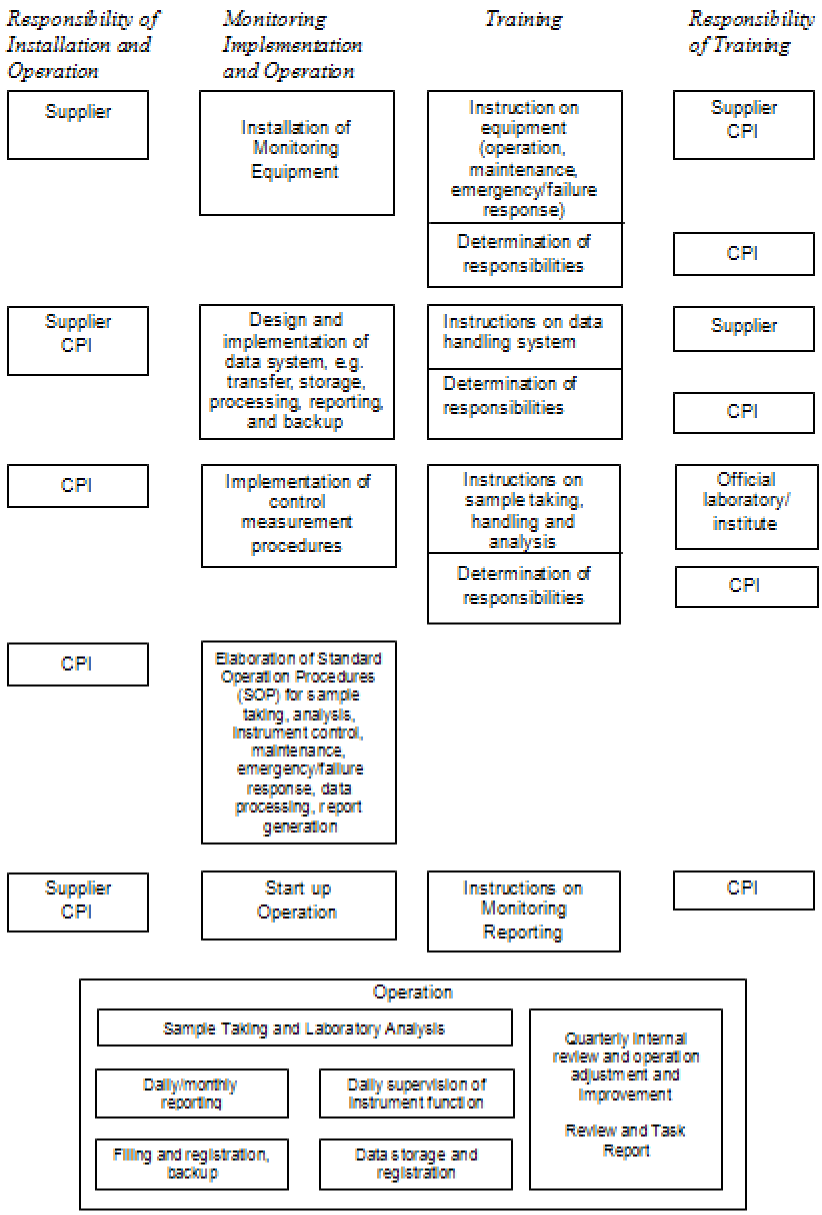

Fig. 5: Monitoring Operation Procedure

All data will be kept for at least two years following the end of the crediting period or the last issuance of CERs (whatever is the later). For all monitoring supervision, maintenance, data storage, data handling and plausibility check measures, standard operation procedures (SOP) will be elaborated. These SOPs will be integrated into the existing ISO 9001:2000 System.

Reconstruction/calculation of data in case of instrument failure

Missing monitoring data derived from instrument failure and during replacement of broken instruments will be reconstructed from former and subsequent series of measurement. Within the first month of monitoring, missing data will not be reconstructed and losses accepted accordingly.
After one month of monitoring and one month data record respectively, missing data will be reconstructed from the average of the lowest measured values of the previous and the following month, if the monitoring interruption is longer than one week (5 working days).
This method is appropriate and conservative, since the flow rates of waste water and biogas as well as the COD content in the waste water and CH_4 content in the biogas are not subject to huge variations in such production processes. To avoid suspicion referring bridging of complete production interruptions, corresponding data from parallel instruments and proved production data from the same period of the

instrument failure will be recorded and documented in order to prove the continuity of the production process. Reconstructed values will be marked in the record and monitoring reports accordingly.

Data Storage

The planned control room for the biogas digester, adjacent to the Biogas plant is used for monitoring data record and processing facilities. The room is ventilated through AC system and will provide shelter for the computer equipment and peripheral equipment (printer, modem).

SECTION D. Data and parameters

This section shall include parameters used to calculate baseline, project, and leakage emissions as well as other relevant parameters required by the approved methodology and the monitoring plan; and specific information on how data and parameters have been monitored during the monitoring period. Data that is determined only once for the crediting period but are used after registration of the project activity should be included here under section D.1.

Provide for each parameter the following information, using the tables provided below:

1. Value of monitored parameter in the period for the purpose of calculating emission reductions. To report multiple values , a table may be used and included in this monitoring report or include references to spreadsheet. For default value (such as an IPCC value), where it is ex-post confirmed, the most recent value shall be applied.
2. Description of the equipment used to monitor each parameter, including details on accuracy class, and calibration information (frequency, date of calibration and validity), if applicable as per monitoring plan.
3. Measuring and recording method: how the parameters are measured/calculated, specifying the measurement and recording frequency.
4. Source of data: logbooks, daily records, surveys, etc.
5. Where relevant, the calculation method of the parameter.
6. The QA/QC procedures applied (if applicable per monitoring plan).
7. Include information about appropriate emission factors, IPCC default values and any other reference values that have been used in the calculation of emission reductions.

Data / Parameter:	**Bo**
Data unit:	kg CH_4/kg COD
Description:	Biogas producing capacity
Source of data used:	Default value as specified in AM0013, based on IPCC default values
Value applied:	0.21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Additional comment:	-

Data / Parameter:	**Hu_PS**
Data unit:	MJ/kg
Description:	Calorific value of palm shells
Source of data used:	Desk Study on Palm Oil Industry in Thailand. Value is based on detailed analysis by Thai-German Program for Enterprise Competitiveness E3AGRO-Project, Desk Study on Palm Oil Industry, Prawat Leetanakul, Bangkok, Thailand, November 2004.
Value(s) :	13.8
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Baseline emissions.

calculations)	
Additional comment:	n.a.

Data / Parameter:	**Hu_HeavyOil**
Data unit:	MJ/litre (40.19 MJ/t @ 0.86 t/litre)
Description:	Calorific value of heavy oil
Source of data used:	Standard default value: IPCC (1996), Module 1, Table 1-3.
Value(s) :	35.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Any comment:	-

Data / Parameter:	**GWP_CH_4**
Data unit:	Number
Description:	Global warming potential of CH_4
Source of data used:	UNFCCC
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Additional comment:	-

Data / Parameter:	**$CEF_{Bl, elec,y}$**
Data unit:	t CO_2/MWh
Description:	CO_2 emission factor for electricity consumed at the project site in the absence of the project activity
Source of data used:	Electricity Generation Authority of Thailand (EGAT), own calculations based on ACM0002 (simple operating margin, see Annex 3)
Value(s) :	0.523
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Additional comment:	-

Data / Parameter:	D_{lng}
Data unit:	M
Description:	Depth of lagoon
Source of data to be used:	Measurement at CPI; Standard depth meter; metering randomly selected and varying places of the lagoons.
Value(s) :	> 5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Additional comment:	-

Data / Parameter:	F_d
Data unit:	%
Description:	Fraction of anaerobic degradation due to depth as per table 1 of AM0013
Source of data to be used:	Standard value as defined in AM0013

Value(s) :	70%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Any comment:	-

Data / Parameter:	E
Data unit:	Cal/mol
Description:	Activation energy constant
Source of data to be used:	Standard value as defined in AM0013
Value(s) :	15.175
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Additional comment:	-

Data / Parameter:	$COD_{a,in}$
Data unit:	kg COD/yr
Description:	COD that enters the lagoon
Source of data to be used:	Laboratory tests at CPI (Method AWWA 5220B.,P5-14,1998)
Value(s) :	Monthly values, see Table 2[1]
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions (*ex ante*).
Any comment:	-

Data / Parameter:	$COD_{a,out}$
Data unit:	kg COD/yr
Description:	COD that leaves lagoon with the effluent
Source of data to be used:	Laboratory tests at CPI
Value(s) :	Monthly values, see Table 2
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions (*ex ante*).
Additional comment:	-

Data / Parameter:	Uncertainty conservativeness factor
Data unit:	-
Description:	Uncertainty conservativeness factor
Source of data to be used:	Standard value as defined in AM0013
Value(s) :	0.89
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions (*ex ante*).
Additional comment:	-

Data / Parameter:	T1

[1] at the end of this section

Data unit:	Kelvin
Description:	Temperature
Source of data to be used:	Standard value as defined in AM0013
Value(s) :	303.16
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions (*ex ante*).
Additional comment:	-

Data / Parameter:	R
Data unit:	Cal/K mol
Description:	Ideal gas constant
Source of data to be used:	Standard value as defined in AM0013
Value(s) :	1.987
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions (*ex ante*).
Additional comment:	-

Data / Parameter:	EG_y
Data unit:	MWh
Description:	Electricity consumption of existing waste water treatment system
Source of data to be used:	CPI; Historical value (measurement with standard electric meter)
Value(s) :	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Additional comment:	-

Data / Parameter:	$CEF_{Bl,therm}$
Data unit:	tCO_2 e/TJ
Description:	CO_2 emissions intensity for thermal energy generation
Source of data to be used:	IPCC standard value for this fuel type, IPCC 1996 Guidelines – Residual Fuel Oil, Table 1-1
Value(s) :	77.37
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Additional comment:	-

Data / Parameter:	HG_{Bl}
Data unit:	MJ
Description:	Quantity of [additional] thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuel
Source of data to be used:	Information provided by CPI, calculation on the basis of energy content of the produced biogas.
Value(s) :	11,172,825
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Baseline emissions.

calculations)	
Additional comment:	Only the additional thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuels is relevant for the calculation of emission reductions. HG_{Bl} is calculated on the basis of annual biogas production (3,238,500 m^3/yr), the calorific value of biogas (0.000023 TJ/Nm^3), and the expectation that 15% of the generated biogas will be used to replace fossil fuel (oil).

Data / Parameter:	**$HG_{p,y}$**
Data unit:	MJ
Description:	Quantity of thermal energy that is consumed in year y at the project site due to the project activity using fossil fuel
Source of data to be used:	Planning data of installation; the new waste water treatment system will not lead to a consumption of thermal energy.
Value(s) :	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Additional comment:	-

Data / Parameter:	$CEF_{Pr,therm,y}$
Data unit:	tCO_2 e/TJ
Description:	CO_2 emissions intensity for thermal energy generation; Biogas is used for generating thermal energy (used at palm oil production, not for waste water treatment system itself)
Source of data to be used:	AM0013
Value(s) :	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Additional comment:	-

Data / Parameter:	EF_{N2O}
Data unit:	Kg N_2O/ Kg N
Description:	Emission factor of nitrogen from sludge applied to land
Source of data to be used:	Application of AM0013
Value(s) :	0.016
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Additional comment:	-

Data / Parameter:	COD_{dw}
Data unit:	kg COD/yr
Description:	Chemical Oxygen Demand in the wastewater from the dewatering process
Source of data to be used:	Installation design; is not applicable, because no dewatering process will take place.
Value(s) :	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.

Additional comment:	-

D.2. Data and parameters monitored	
Data / Parameter:	**T2**
Data unit:	K
Description:	Ambient temperature (Kelvin) for the climate
Measured /Calculated /Default:	Measured.
Source of data:	Weather station Chumporn
Value(s) of monitored parameter:	Monthly Averages (2005): See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	n.a
QA/QC procedures applied:	Internal double-check of using the correct values.

Data / Parameter:	F_{Dig}, F_{Dig_out}
Data unit:	m^3 / yr
Description:	Flow rate of organic wastewater into the digester
Measured /Calculated /Default:	Measured.
Source of data:	Measurement
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions / Project emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Flow rates will be continuously recorded with Vortex Flow Meter or similar, installed at least 5 diameters of discharge pipe up- and downstream away from any flow disturbance (e.g. sample points, valves, etc.). An isolating valve will be installed upstream of the meter for maintenance purposes. Accuracy < ± 1 % of actual flow at the lowest typical flow. Hourly values will be transferred online and recorded.
Measuring/ Reading/ Recording frequency:	Aggregated monthly
Calculation method (if	<u>Calibration:</u> continuous vortex or similar flow meter will be calibrated

applicable):	by manufacturer or approved company at the time of installation. Frequency of subsequent calibration will be appropriate to the application, but not less than half-yearly re-calibration to ensure accuracy of < ± 1% at lowest plant specific flow rate. Each time the meter is calibrated, an On-Site-Calibration-Report will be submitted to CPI.
QA/QC procedures applied:	Inspection and Maintenance: Meters will be installed such to enable easy inspection at least half-yearly and are not to be installed where they will or may be submerged. Installation will also facilitate separation valves for meter removal and repair and recalibration. For this purpose, a spare meter will be held on stock, to avoid long time loss of data record. O&M staff of the digester will be trained to maintain the meters in accordance with the manufacturer's requirements. Meters will be daily inspected by CPI staff and repaired as necessary by a service provider approved by the manufacturer. Laboratory and QA/QC staff will train O&M staff for data reading in parallel to online data transfer. Data storage: Online transfer to computer. Weekly data backup to CD. Data Preparation and reporting: Counter control routine between digester inlet and outlet. Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed – two copies will be filed at factory and headquarters respectively.

Data / Parameter:	$COD_{c, baseline}$
Data unit:	kg COD/m^3
Description:	COD - concentration of organic wastewater into the digester
Measured /Calculated /Default:	Measured.
Source of data:	Laboratory tests at CPI (monthly) – Method: AWWA 5220B.,P5-14,1998
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Sample points at digester inlets. Method US EPA 410.4. 50 – 100 ml in glass bottles per sample. 4 samples per hour, 12 samples per day (weekly same day, same times), preparation of composite samples. Homogenizing of samples. Preservation: H_2SO_4 to pH < 2, 4 °C ±2 °C. Additionally, temperature and pH will be recorded synchronously with existing sensors. **Laboratory tests at CPI laboratory** "Potassium Dichromate Digestion" – analysis. Accuracy according US EPA Standard Range Method: four replicates of each of 30 samples averaged ± 2.7%. Samples of wastewater are refluxed in strong acid solution with a known excess of potassium dichromate (K_2Cr_2O7). After digestion, the remaining unreduced $K_2Cr_2O_7$ is titrated with ferrous ammonium sulfate to determine the amount of $K_2Cr_2O_7$ consumed, and the oxidizable matter is calculated in terms of oxygen equivalent. Ratios of reagent weights, volumes, and strengths are kept constant when sample

	volumes other than 50 ml are used. The standard 2-h reflux time may be reduced if a shorter period yields the same results. Some samples with very low COD or high heterogeneous solid content may need to be analyzed and replicated to yield the most reliable data. Reacting the maximum quantity of dichromate enhances results further, provided some residual dichromate remains.
Measuring/ Reading/ Recording frequency:	Measurement at least monthly.
Calculation method (if applicable):	Calibration: Regular calibration by manufacturer or approved company (half-yearly) – calibration report to CPI.
QA/QC procedures applied:	• Sampling will be carried out adhering to internationally recognized procedures. *Alternative 1:* Manual sample and laboratory analysis. CPI runs its own laboratory with appropriate sampling and analysis equipment. CPI and its laboratory are certified ISO 9001:2000. CPI will elaborate standard operation procedures (SOP) and QC/QA instructions according to ISO9001:2000 for sampling taking and laboratory practice. Equipment supplier and internal laboratory staff and QA staff will train O&M staff to take samples according international standard requirements. Sample and analyzing accuracy will be < ± 3 %. • *Alternative 2*: Automatic continuous measurement. Method: Electrochemical oxidation. Sample Preparation: Maintenance free particle separator. Calibration: Regular calibration by manufacturer or approved company (half-yearly) – calibration report to CPI. Cross-Checks: If automatic monitoring will be installed, additional quarterly sample will be taken and potassium dichromate digestion analysis carried out. The results will be stored in computer and comparison routines will check these data with quarterly average data from continuous monitoring system. Data capture/storage: Data capture at the laboratory/IT-center resp. online transfer, if continuous monitoring system will be used. Weekly data backup on CD of CDM specific data will be carried out by data management (MIS) staff. Data will be stored for 10 years of CDM project duration and 2 years afterwards. Data backup procedure valid for the overall monitoring. Data Preparation and reporting: Data plausibility routines will check data reliability and data comparison automatically. Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed – two copies will be filed at factory and headquarters respectively. Half-yearly control sampling and analysis by accredited laboratory.

Data / Parameter:	$COD_{a,in}$
Data unit:	kg COD/yr
Description:	COD that enters the lagoon
Measured /Calculated /Default:	Calculated.
Source of data:	Laboratory tests at CPI (monthly) – Method: AWWA 5220B.,P5-14,1998
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Baseline emissions.

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See description at $COD_{c, baseline}$.
Measuring/ Reading/ Recording frequency:	Measurement at least monthly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at $COD_{c, baseline}$.

Data / Parameter:	$COD_{a,ou}$
Data unit:	kg COD/yr
Description:	COD that leaves the lagoon
Measured /Calculated /Default:	Calculated.
Source of data:	Laboratory tests at CPI, Method: AWWA 5220B.,P5-14,1998
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See description at $COD_{c, baseline}$.
Measuring/ Reading/ Recording frequency:	Measurement at least monthly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at CODc, baseline.

Data / Parameter:	T_{lng}
Data unit:	K
Description:	Temperature of the lagoon
Measured /Calculated /Default:	Measured.
Source of data:	Measurement at lagoon.
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Standard industrial temperature meter. Daily measurements; calculation of monthly average.
Measuring/ Reading/	Monthly.

Recording frequency:	
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	Internal double-check of using the correct values.

Data / Parameter:	D_{lng}
Data unit:	M
Description:	Depth of the lagoons
Measured /Calculated /Default:	Measured.
Source of data:	Measurements by CPI
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Standard depth meter. Monthly measurements; calculation of yearly average.
Measuring/ Reading/ Recording frequency:	Monthly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Data / Parameter:	HG_{Bl}
Data unit:	MJ
Description:	Quantity of [additional] thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel
Measured /Calculated /Default:	Calculated.
Source of data:	Calculation based on calorific values and quantity of biogas as well as standard calorific values of fossil fuels (heavy oil).
Value(s) of monitored parameter:	11,172,825
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Only the additional thermal energy that would be consumed in year y at the project site in the absence of the project activity using fossil fuels is relevant for the calculation of emission reductions. HG_{Bl} is calculated on the basis of annual biogas production (3,238,500 m^3/yr), the calorific value of biogas (0.000023 TJ/Nm^3), and the expectation that 15% of the generated biogas will be used to replace fossil fuel (oil).
Measuring/ Reading/ Recording frequency:	Monthly.
Calculation method (if applicable):	n.a.

QA/QC procedures applied:	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Data / Parameter:	COD_{c,dig_out}
Data unit:	kg COD/m^3
Description:	COD-concentration in discharged effluent from digester
Measured /Calculated /Default:	Measured.
Source of data:	Measurements by CPI (monthly)
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emissions / Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See description at $COD_{c, baseline}$.
Measuring/ Reading/ Recording frequency:	Measurement at least monthly.
Calculation method (if applicable):	<u>Calibration:</u> Regular calibration by manufacturer or approved company (half-yearly) – calibration report to CPI.
QA/QC procedures applied:	See description at $COD_{c, baseline}$.

Data / Parameter:	$EL_{P,y}$
Data unit:	MWh/yr
Description:	Amount of electricity in the year y that is consumed at the project site for the project activity
Measured /Calculated /Default:	Measured.
Source of data:	Measurements at CPI
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Standard electricity meter (separate meter for waste water plant); continuous measurement. A separate and officially calibrated electric meter will be connected to the main electricity supply of the overall biogas plant.
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	Yearly calibration by official organization or authorized company. No further steps are applicable due to external quality control (electricity provider).

Data / Parameter:	F_{la}
Data unit:	kg/yr

Description:	Quantity of sludge used for land application after dewatering
Measured /Calculated /Default:	Measured.
Source of data:	Measurements by CPI
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Weighing of trucks with standard industrial weighbridge.
Measuring/ Reading/ Recording frequency:	At times of sludge application continuously (every truck).
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Data / Parameter:	COD_{la}
Data unit:	kg COD/m^3
Description:	COD of the sludge used for land application after dewatering
Measured /Calculated /Default:	Measured.
Source of data:	Measurements by CPI (laboratory), Method: AWWA 5220B.,P5-14,1998
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See description at $COD_{c,\ baseline}$.
Measuring/ Reading/ Recording frequency:	At times of sludge application.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at $COD_{c,\ baseline}$.

Data / Parameter:	$F_{c,dw}$
Data unit:	m^3/yr
Description:	Flow rate of organic wastewater from the dewatering process
Measured /Calculated /Default:	Measured.
Source of data:	n.a.
Value(s) of monitored parameter:	Not applicable, because the project activity does not include a dewatering process.

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	n.a.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Data / Parameter:	$COD_{c,dw}$
Data unit:	kg COD/yr
Description:	COD of the wastewater from the dewatering process
Measured /Calculated /Default:	Measured.
Source of data:	n.a.
Value(s) of monitored parameter:	n.a. because no dewatering takes place.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	n.a.
Measuring/ Reading/ Recording frequency:	n.a.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Data / Parameter:	FR_{Bio}
Data unit:	m^3/yr
Description:	Biogas flow rate at digester outlet (two lines are considered)
Measured /Calculated /Default:	Measured.
Source of data:	Measurements
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last	Application of Coriolis Mass Flow Meter or similar (measurement range 100 – 500 kg/hr at 0.717 kg/m3). Measure points at each digester line outlet. Accuracy <± 1 % at 2 - 100 % of 8 kg/min. Hourly values will be transferred online and recorded.

calibration, validity)	
Measuring/ Reading/ Recording frequency:	Continuous measurement with daily reading.
Calculation method (if applicable):	Regular Calibration of Coriolis flow meter or similar by manufacturer or approved company (half-yearly) – calibration report to CPI. QC staff of CPI will be trained on calibration control and on malfunction recognition. Subsequent calibration control every month will be appropriate to the application to assure accuracy of ± 2%. Each time the meter is calibrated by approved companies, an On-Site-Calibration-Report will be supplied to CPI. Calibration control and adjustments by CPI-QC staff will be recorded
QA/QC procedures applied:	QC of meter function: One flow meter for each outlet 1 and 2 will be installed. Data of the meter will be sent to a computer. Computer program will cross-check total digester outlet 1 and 2 with Sum of inlet at 5, 6, and 10. Flow meter malfunction or leakages can thus be detected. Daily flow meter function inspection. Cross-check accuracy set to ± 2 %. A spare flow meter will be held on stock for immediate change if needed at any place of gas pipes. Separation valves will allow deviation of gas flow through second line during exchange of meter. Range of meter will allow to measure full flow. Data recording and storage: Online transfer to computer. Weekly data backup to CD. Data preparation and reporting: Aggregation to 24 hrs average, weekly, monthly and quarterly rates by routines. Monthly aggregated reports will be printed – two copies will be filed at factory and headquarters respectively.

Data / Parameter:	$P_{CH4,bio}$
Data unit:	Ppm
Description:	Biogas CH_4 content at digester outlet (measurements at each digester line)
Measured /Calculated /Default:	Measured.
Source of data:	Measurement (quarterly)
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	CH_4 content will be determined through electronic probe and analysis: Non-Dispersion Infrared method (NDIR). Preferably application of portable analyzer (range 0 -100vol%). The average of 12 months will be calculated and transformed in [%] of biogas.
Measuring/ Reading/ Recording frequency:	Daily.
Calculation method (if applicable):	Regular calibration by manufacturer or by approved company (half-yearly or before each measurement period, if portable equipment are used) – calibration report to CPI. QC staff of CPI will be trained on calibration control and on malfunction recognition.
QA/QC procedures applied:	Average of at least 5 control measurements at 1 hr frequency (portable analyzer). Accuracy of equipment < ± 1 % at full scale. Accuracy of Method (portable analyzer): < ± 2 % due to relatively stable production process and low variation of CH_4 production.

	Data recording/storage: Data logger reading or online transfer to computer. Weekly data backup to CD.

Data / Parameter:	$FR_{f,inlet}$
Data unit:	m^3/hr
Description:	Biogas flow rate at flare inlet
Measured /Calculated /Default:	Measured.
Source of data:	Measurement / calculation
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Two gas flow meters of standard type are currently being considered for installation. Vortex Flow Meter, 4" meter size, Model VFM 7700 or Kobold DOG-1119L
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at FR_{Bio}.

Data / Parameter:	$T_{comb,f}$
Data unit:	hrs/yr
Description:	Fraction of time gas is combusted in the flare
Measured /Calculated /Default:	Measured.
Source of data:	Measurement
Value(s) of monitored parameter:	16
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The gas flow to the flare is controlled by a pressure control system: If gas flows to the boiler stops, pressure in biogas storage bag will raise. If this pressure exceeds a certain level, a signal will be send to gas blower which will switch on pump. This starts gas pumping to the flare. The ignition of the flare is being controlled by pressure. If pressure increases, a signal will be send to switch to ignite the flame. Two gas flow meters of standard type are currently being considered for installation: Vortex Flow Meter, 4" meter size, Model VFM 7700 or Kobold DOG-1119L. For detail specification please refer to http://www.forbesmarshallinc.com/intops/images/VFM%207700.pdf and http://www.kobold.com.pl/dropzone/pdfy/s5-dog-1_dog-3_dog-2_en.pdf
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if	n.a.

applicable):	
QA/QC procedures applied:	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Data / Parameter:	$PE_{flare, y}$
Data unit:	t CO_{2e}
Description:	Project emissions from flaring of the residual gas stream in year y
Measured /Calculated /Default:	Calculated.
Source of data:	Calculation based on $FR_{f,inlet}$,, $PCH_{4,f,s}$, and $T_{comb,f}$
Value(s) of monitored parameter:	See spreadsheet: MR CPI ER Calculation_2010-11-08.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	$PE_{flare, y}$ will be calculated as the annual amount of CH_4 being utilized in the flare [t/yr] times the standard flare efficiency of 0.5 times the GWP of CH_4 (21): $PE_{flare, y} = (M_{CH4, flare} * 0.5 * 21)/1000$ in [t/yr] The annual amount of CH_4 being utilized in the flare ($M_{CH4, flare}$) will be calculated as: $M_{CH4, flare} = V_{Bio, flare} * \rho_{Bio, flare} * P_{CH4,bio}$ in [kg/yr] Where $V_{Bio, flare}$ = Annual volumetric flow of biogas at norm conditions = $(FR_{f,inlet} * T_{comb,f}) * (1+27.3°C^{2} / 273.15°C)$ $\rho_{Bio, flare}$ = Density of biogas at norm conditions = $P_{CH4,bio} * 0.717$ kg/m³ + $(1- P_{CH4,bio}) * 1.251$ kg/ m³ Remarks: ▪ The calculation of the density of the biogas is based on the simplified assumption that the biogas consists of CH_4 and N_2 only. This is in line with the TME, page 5. ▪ 0.717 kg/m³ is the density of CH_4 at norm conditions, 1.251 kg/ m³ is the density of N_2 at norm conditions (http://www.biologie.de/biowiki/Liste_der_Dichte_gasf%C3%B6rmiger_Stoffe)
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See $T_{comb,f}$ and $FR_{f,inlet}$.

Data / Parameter:	$FR_{e,inlet}$
Data unit:	m3/yr
Description:	Flow rate of the biogas entering the heat generation equipment
Measured /Calculated /Default:	Measured.
Source of data:	CPI Measurement.
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are	Project Emissions.

[2] 27.3 °C is the average annual temperature at the project site.

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The valve at the biogas burner is controlled by UV detector (flame control) and/or pressure drop at gas storage. Two gas flow meters of standard type are currently being considered for installation: Vortex Flow Meter, 4" meter size, Model VFM 7700 or Kobold DOG-1119L.
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at FR_{Bio}.

Data / Parameter:	$FR_{e,s}$
Data unit:	m^3/yr
Description:	Flow rate of the heat generation equipment stack gases
Measured /Calculated /Default:	Measured.
Source of data:	Measurement
Value(s) of monitored parameter:	n.a.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Application of Coriolis Mass Flow Meter or similar (measurement range 3000 m^3/min. at 290 C). Measure points at stack of boiler. Accuracy <± 2 % at flow rate. Hourly values will be transferred online and recorded.
Measuring/ Reading/ Recording frequency:	Quarter-yearly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at FR_{Bio}.

Data / Parameter:	$P_{CH4,e,s}$
Data unit:	Ppm
Description:	Methane content in stack gas of heat generation stack gases.
Measured /Calculated /Default:	Measured.
Source of data:	Measurement (quarterly)
Value(s) of monitored parameter:	3.12
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	CH_4 content will be determined through electronic probe and analysis: Non- Dispersion Infrared method (NDIR). Preferably application of portable analyzer. Accuracy of Method (portable analyzer): < ± 2 % due to relatively stable production process and low variation of CH_4 production. The average of 12 months will be calculated and transformed in [% of

	biogas].
Measuring/ Reading/ Recording frequency:	Quarter-yearly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	See description at $P_{CH4,bio.}$

Data / Parameter:	$T_{comb,e}$
Data unit:	hrs/yr
Description:	Fraction of time gas is combusted in the heat generation equipment.
Measured /Calculated /Default:	Measured.
Source of data:	Measurement
Value(s) of monitored parameter:	n.a
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The valve at the biogas burner is controlled by UV detector (flame control) and/or pressure drop at gas storage. Two gas flow meters of standard type are currently being considered for installation: Vortex Flow Meter, 4" meter size, Model VFM 7700 or Kobold DOG-1119L. For detailed specification please refer to http://www.forbesmarshallinc.com/intops/images/VFM%207700.pdf and http://www.kobold.com.pl/dropzone/pdfy/s5-dog-1_dog-3_dog-2_en.pdf
Measuring/ Reading/ Recording frequency:	Continuously.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	*QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.*

Data / Parameter:	Sa
Data unit:	kg/yr
Description:	Amount of sludge applied to land
Measured /Calculated /Default:	Measured.
Source of data:	Measurement
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	*Weighing of trucks with standard industrial weight truck.*
Measuring/ Reading/ Recording frequency:	Continuous at times of sludge application.
Calculation method (if	n.a.

applicable):	
QA/QC procedures applied:	*QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.*

Data / Parameter:	NC
Data unit:	kg N/kg sludge
Description:	Nitrogen content in the sludge
Measured /Calculated /Default:	Measured.
Source of data:	Monthly measurements
Value(s) of monitored parameter:	See spreadsheets: Report CDM Monitoring Data 2009.xls, Report CDM Monitoring Data 2010.xls
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Laboratory tests at CPI laboratory – Kjeidahl Method (Total Kjeldahl Nitrogen 3094 mg/L as N)
Measuring/ Reading/ Recording frequency:	At times of sludge application.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	QS/QA procedures according to ISO 9000:2000 scheme set up by CPI.

Data / Parameter:	EGy
Data unit:	MWh
Description:	Amount of electricity in the year y that would be consumed at the project site in the absence of the project activity
Measured /Calculated /Default:	Measured.
Source of data:	Historical data provided by CPI
Value(s) of monitored parameter:	78.2225
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Standard industrial electrical metering meters (accuracies: Power ± 0.5%, Current± 0.3, %Energy ± 1%, Power factor± 0.5%,Frequency± 0.1%)
Measuring/ Reading/ Recording frequency:	Historic data. Ex-ante.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	External control by electricity provider.

Data / Parameter:	NCV_BG
Data unit:	MJ/m3
Description:	Net calorific value of biogas (dry)
Measured /Calculated	Measured.

/Default:	
Source of data:	Measurement by PTT chemical public company limited
Value(s) of monitored parameter:	23
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Laboratory tests at PTT chemical public company limited Methane Method ASTM D 1945-91 Total Hydrocarbons(C2-C5) Method ASTM D 2712-91
Measuring/ Reading/ Recording frequency:	Quarter-yearly.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Data / Parameter:	T_{Fl}
Data unit:	K
Description:	Temperature of Flare
Measured /Calculated /Default:	Measured.
Source of data:	Automatic measurement
Value(s) of monitored parameter:	n.a.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Measurement temperature by Thermocouple transmitter type S . Accuracy ± 0.3% of FS.
Measuring/ Reading/ Recording frequency:	At time of flare use.
Calculation method (if applicable):	n.a.
QA/QC procedures applied:	n.a.

Additional explanations regarding the calculation of baseline emissions:

For ex-ante baseline calculations, values from 2006 are taken for F_{dig}, COD_{in}, and COD_{out}. All data are based on measurements; COD-data is calculated on the basis of measured BOD-data. Table 2 summarises the monthly values for 2006.

Table 2: Results of wastewater analysis 2006

WASTE WATER Analysis Results 2006

WASTE WATER	DETAIL	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
Process CPO	COD [mg/l]	73,750	0	92,248	96,250	97,845	84,583	21,555	68,333	0	70,417	64,750	70,833
Process Refinery 1		1,103	0	0	1,952	128	792	832	233	11,915	875	2,358	3,208
Process Refinery 2	Caculate	1,192	1,417	0	1,317	6,218	800	960	85	3,782	88	688	367
Last pond		542	650	1,153	783	237	667	337	822	262	1,458	172	942
F_dig (CPO)	m3/month	4,551	8,856	16,026	17,098	16,593	13,992	10,155	8,717	9,717	11,561	11,296	9,368
F_dig (Refinery)	m3/month	6,556	6,306	8,100	6,475	7,913	7,869	5,700	8,050	7,594	8,756	8,413	8,113
COD_in (CPO)	COD [kg/month]	335,625	0	1,478,409	1,645,683	1,623,581	1,183,528	218,894	595,692	0	814,098	731,422	663,574
COD_in (Refinery)	COD [kg/month]	7,523	8,934	0	10,581	25,109	6,262	5,106	1,281	59,598	4,218	12,815	14,501
COD_out (Last pond)	COD [kg/month]	6,016	9,856	27,826	18,466	5,800	14,574	5,338	13,777	4,530	29,630	3,383	16,461

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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Emission reductions are calculated as the difference between baseline emissions and project emissions strictly in line with the provisions and formulas defined in AM0013.

<u>Baseline emissions include:</u>

- Lagoon baseline emissions
- Electricity/heat baseline emissions

Baseline emission is calculated in the following manner:

$$BE_y = BE_{lagoon,y} + BE_{heat,y}$$

$$= MIN\ \{BE_{lagoon,theoretical,y} : BE_{lagoon,monitored,y}\} + BE_{heat\_oil,y}$$

A) $BE_{lagoon,y}$

As described in AM0013 version 04, the lower of the two shall be assumed as the baseline emissions:

(i) baseline methane emission less the physical leakage, hereafter referred as "$BE_{lagoon,theoretical,y}$"; and

(ii) actual methane captured and flared/used for energy generation, hereafter referred as "$BE_{lagoon,monitored,\ y}$"

(i) Lagoon Baseline Emissions - theoretical

CH_4 emissions (kg/yr)	=	Total $COD_{available,m}$ (kg COD/month)	x	B_o (kg CH_4/kg COD)	x	$MCF_{baseline}$

where:

$COD_{available,m}$	Is the monthly Chemical Oxygen Demand available for conversion which is equal to the monthly COD entering the digester or directed to land application $COD_{baseline,m}$ plus COD carried on from the previous month.
$COD_{baseline,m}$	Is the monthly Chemical Oxygen Demand of effluent entering lagoons or directed to land application (measured)
B_o	Is the maximum methane producing capacity
$MCF_{baseline}$	Is the monthly methane conversion factor (fraction)

As there is effluent from the lagoons in the baseline, $COD_{baseline}$ is multiplied by the factor AD:

$$AD = 1 - \left(\frac{COD_{a,out}}{COD_{a,in}} \right)$$

where:

$COD_{a,out}$	is the COD that leaves the lagoon with the effluent
$COD_{a,in}$	is the COD that enters the lagoon

Lagoon baseline emissions are calculated based on the chemical oxygen demand (COD) of the effluent that would enter the lagoon in the absence of the project activity, the maximum methane producing capacity (B_o) and a methane conversion factor (MCF) that expresses what proportion of the effluent would be anaerobically digested in the open lagoons:

$$CH_4 \text{ emissions} = \text{Total } COD_{available,m} \times B_o \times MCF_{baseline}$$

$$= 5{,}222{,}863 \text{ kg } CH_4$$

Monthly caluculation of CH_4 emissions from baseline lagoon are shown in the spreadsheet "MR CPI_CER Calculation_2010-11-08.xls"

In line with AM0013, the total baseline CH_4 emissions are translated into CO_2 equivalent emissions by multiplying by its global warming potential (GWP) of 21.

BE_L = 109,680 t CO_2-e

$BE_{lagoon,theoretical,y} = BE_L - PE_{leakage\ digester}$

$= (109{,}680 - 7{,}068)$ t CO_2-e

$= 102{,}612$ t CO_2-e

(ii) Lagoon Baseline Emissions - monitored

$BE_{lagoon,\ monitored,y} = (BE_{biogas,boiler,y} + BE_{biogas,flare,y}) - PE_{flare}$

$= ((46{,}390 + 7{,}547) - 3{,}774))$ t CO_2-e

$= 50{,}163\ t\ CO_2\text{-}e$

Monthly caluculation of CH_4 emissions from baseline lagoon (biogas to boiler and flare) are shown in the spreadsheet “MR CPI_CER Calculation_2010-11-08.xls”

B) Electricity/heat baseline emissions

Electricity baseline emissions are not relevant for the underlying project, as it does not involve generation of electricity.

Heat baseline emissions are calculated as:

$BE_{heat} = HG_{Bl,y} * CEF_{Bl,therm,y}$

where $HG_{Bl,y}$ is the quantity of thermal energy that would be consumed in year y at the project site in the absence of the project activity (MJ) using fossil fuel.
$CEF_{Bl,\ therm}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2 e/MJ).

$BE_{heat} = 15.96\ TJ * 77.37\ tCO2 / TJ$

$BE_{heat} = 1{,}235\ tCO_2\text{-}e$

Monthly caluculation of CH_4 emissions from baseline heat generation are shown in the spreadsheet “MR CPI_CER Calculation_2010-11-08.xls”

C) Total baseline emissions

In accordance with AM0013, a comparison between

(i) baseline methane emission less the physical leakage ($BE_{lagoon,theoretical,y}$), and

(ii) the actual methane captured and flared/used for energy generation ($BE_{lagoon,monitored,y}$)

have been made as shown in table below:

Table 3: Comparison of theoretical and monitored baseline emissions

	“$BE_{lagoon,theoretical,y}$” ($t\ CO_2\text{-}e$)	“$BE_{lagoon,monitored,\ y}$” ($t\ CO_2\text{-}e$)
Total	102,612	50,163

The actual methane captured and flare used for energy generation ($BE_{lagoon,monitored,y}$) is lower and therefore has to be used as baseline methane emission from open lagoon.
($BE_{lagoon,\ y} = BE_{lagoon,monitored,y} = 50{,}163\ tCO_2\text{-}e$)

$BE_{total,y} = BE_{lagoon,y} + BE_{heat,y}$

$= 50{,}163\ t\ CO_2\text{-}e + 1{,}235\ tCO_2\text{-}e$

$BE_{total,y}$ = 51,398 tCO_2-e

E.2. Project emissions calculation

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Project Emissions

The physical delineation of the project is defined as the plant site. Project emissions mainly consist of methane emissions from the lagoons, physical leakage from the digester system, stack emissions from flaring and energy generating equipment, emissions related with the consumption of electricity in the digester auxiliary equipment, emissions from land application of sludge, and emissions from wastewater removed in the dewatering process.

(i) Methane emissions from lagoons

After the majority of the COD is treated and reduced by anaerobic digestion, the effluent will pass through the ponds prior to release. A significant majority of the COD load will have been reduced by anaerobic digestion and the ponds are expected to operate under largely aerobic conditions. The MCF value for fully aerobic systems is 0, as no methane is produced.

However, due to the uncertainty regarding the exact extent of aerobic/anaerobic digestion after project implementation, the calculation of these CH_4 emissions is conservatively carried out in the same way as for the baseline, using the same values for B_o and the methane conversion factor (MCF):

Formula for the calculation of project methane emissions from lagoons as in AM0013:

CH_4 emissions from the lagoons (kg/yr)	=	COD_{dig_out} (kg COD/yr)	X	B_o (kg CH_4/kg COD)	x	MCF_{dig_out}

Where:

COD_{dig_out} Is Chemical Oxygen Demand of effluent entering lagoons (measured)

B_o Is maximum methane producing capacity

MCF_{dig_out} Is methane conversion factor (fraction) estimated as described in the baseline section above

CH_4 emissions = 478,217 kg CH_4

Monthly calculations of CH_4 emissions from lagoon are shown in the spreadsheet "MR CPI_CER Calculation_2010-11-08.xls"

In line with AM0013, the total baseline CH_4 emissions are translated into CO_2 equivalent emissions by multiplying by its global warming potential (GWP) of 21.

PE_{lagoon} = 10,043 t CO_2-e

(ii) Physical Leakage from biodigesters

The emissions directly associated with the digesters involve the physical leakage from the digester system. IPCC guidelines specify physical leakage from anaerobic digesters as being 15% of total biogas production.

Physical leakage from the biodigesters has been calculated based on the total amount of biogas produced (5,441,079 m^3) and the methane fraction of biogas (average P_{CH4} = 57.47%).

$PE_{leakage\ digester}$ = 7,068 t CO_2-e

Monthly calculations of CH_4 emissions from biodigersters are shown in the spreadsheet "MR CPI_CER Calculation_2010-11-08.xls"

(iii) Stack emissions from the flare or energy generation

Methane may be released as a result of incomplete combustion either in the flaring option or in case of biogas use for electricity and/or heat production.

Project Emission from stack gas of flare and energy generation has been calculated based on the amount of biogas into the energy generation equipment and flare.

$PE_{flare, y}$ is calculated as the annual amount of CH_4 being utilized in the flare [t/yr] times the standard flare efficiency of 0.5 times the GWP of CH_4 (21):

$$PE_{flare, y} = (M_{CH4, flare} * 0.5 * 21)/1000 \quad \text{in [t/yr]}$$

The annual amount of CH_4 being utilized in the flare ($M_{CH4, flare}$) will be calculated as:

$M_{CH4, flare} = V_{Bio, flare} * \rho_{Bio, flare} * P_{CH4,bio}$ in [kg/yr]

Where

$V_{Bio, flare}$ = Annual volumetric flow of biogas at norm conditions = $(FR_{f,inlet} * T_{comb,f}) * (1+27.3°C^3 / 273.15°C)$

$\rho_{Bio, flare}$ = Density of biogas at norm conditions = $P_{CH4,bio} * 0.717$ kg/m³ + $(1- P_{CH4,bio}) * 1.251$ kg/ m³

$PE_{flare, y}$ = 3,774 t CO_2-e

Monthly calculations of CH_4 emissions from flaring are shown in the spreadsheet "MR CPI_CER Calculation_2010-11-08.xls"

PE_{stack} = 17 t CO_2-e

Monthly calculations of CH_4 emissions from stack gas are shown in the spreadsheet "MR CPI_CER Calculation_2010-11-08.xls"

(iv) Emissions from heat use and electricity use due to the project activity (PEelec/heat):

$$PE_{elec/heat} = EL_y * CEF_d + HG_{Pr,y} * CEF_{Pr,therm,y}$$

where,

$EL_{P,y}$	is the amount of electricity in the year y that is consumed at the project site for the project activity (MWh).
$CEFd$	is the CO_2 emissions factor for electricity consumed at the project site during the project activity (tCO_2/MWh), estimated as described below. Factor is zero if biogas is used to produce electricity.
$HG_{Pr,y}$	is the quantity of thermal energy consumed in year y at the project site due to the project activity (MJ).
$CEF_{Pr, therm,y}$	is the CO_2 emissions intensity for thermal energy generation (tCO2e/MJ), estimated as per method described for baseline thermal energy use. Factor is zero if biogas is used for generating thermal energy.

CEF_d is calculated in line with ACM002. PE_{heat} is not relevant for the underlying project, as no additional heat is consumed due to the project activity.

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[3] 27.3 °C is the average annual temperature at the project site.

PE_{elec} = $El_y * CEF_d$

= 309 MWh * 0.523 t CO_2-e/MWh

PE_{elec} = 162 tCO_2-e

(v) Emissions from land application of sludge

For conservativeness, an MCF of 0.05 is to be used to estimate possible methane emissions from the land application treatment process to account for any possible anaerobic pockets. These emissions are to be estimated from the following equation:

$$\underset{(kg/yr)}{CH_4 \text{ emissions}} = \underset{(kg\ COD/yr)}{\text{Total } COD_{la}} \times \underset{(kg\ CH_4/kg\ COD)}{B_o} \times MCF_{la}$$

Where:

COD_{la} Is Chemical Oxygen Demand of the sludge used for land application after dewatering (measured)

B_o Is maximum methane producing capacity

MCF_{la} Is methane conversion factor (fraction) assumed to be equal to 0.05

And

$$\underset{(kg/yr)}{N_2O \text{ emissions}} = \underset{(kg\ sludge/yr)}{S_a} \times \underset{(kg\ N/kg\ sludge)}{NC} \times EF_{N2O}$$

Where:

S_a Is the amount of sludge applied to land in kg per year

NC Is the nitrogen content in the sludge in (Kg N/Kg sludge)

EF_{N2O} Is the emission factor of nitrogen from sludge applied to land to be assumed 0.016 kg N_2O/ Kg N

Emissions from wastewater removed in the dewatering process are not relevant to the project activity, as no dewatering process takes place.

No sludge application has taken place during the monitoring period (S_a = 0).

PE_{sludge} = 0 t CO_2-e

Table 4: Summary of Project Emissions

Year	PE Lagoon (tCO_2)	PE Stack (tCO_2)	PE Physical Leakage (tCO_2)[1]	PE Sludge application (tCO_2)	PE Electricity (tCO_2)	PE total (tCO_2)
Jan-09	0	0	0	0	0	0
Feb-09	35	0	0	0	1	36
Mar-09	178	0	0	0	6	185
Apr-09	148	0	0	0	5	153
May-09	206	1	0	0	7	213
Jun-09	589	1	0	0	8	597
Jul-09	613	1	0	0	8	622
Aug-09	700	1	0	0	10	711
Sep-09	709	1	0	0	11	721

Oct-09	763	1	0	0	10	774
Nov-09	511	1	0	0	9	520
Dec-09	326	1	0	0	10	336
Jan-10	305	0	0	0	9	315
Feb-10	298	1	0	0	10	308
Mar-10	436	1	0	0	9	446
Apr-10	473	1	0	0	8	481
May-10	875	1	0	0	10	886
Jun-10	838	1	0	0	9	848
Jul-10	790	2	0	0	11	802
Aug-10	1,251	2	0	0	11	1,264
Total	**10,043**	**17**	**0**	**0**	**162**	**10,221**

E.3. Leakage calculation

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No leakage is associated with the project activity.

E.4. Emission reductions calculation / table

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Consistent with AM0013, the emission reduction achieved during this monitoring period is calculated from difference between baseline emission in year y (BE_y) and project emission in year y (PE_y) as:

$ER_y = BE_y - PE_y$

Emission reductions

41,177	**t CO_2-e**	**Total**
<u>Baseline Emissions</u>		
51,398	**t CO2e**	**Total**
50,163	t CO2e	(i) Lagoon ($BE_{lagoon,monitored,y} = (BE_{biogas,boiler,y} + BE_{biogas,flare,y}) - PE_{flare}$)
1,235	t CO2e	(ii) Power/Heat
<u>Project Emissions</u>		
10,221	**t CO2-e**	**Total**
10,043	t CO2-e	(i) Lagoon
17	t CO2-e	(iii) Stack emission energy generation
162	t CO2-e	(iv) Power/Heat
0	t CO2-e	(v) Emissions from land application of sludge
3,774	t CO2-e	(iii) Emissions from flaring biogas (accounted for under (i) Lagoon)
<u>Leakage(*)</u>		
7,068	**t CO2-e**	**Total (= (ii) Physical Leakage from biodigesters))**

(*) The baseline case (ii) is applicable (actual methane captured and flared/used for energy generation), therefore the physical leakage from anaerobic digester for estimating emissions reduction shall be taken as zero.

The emission reduction achieved due to the project activity during 09. February 2009 to 31. August 2010 is **41,177 t CO_2-e**.

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

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Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	37,126*	41,177

*emission reductions in the registered CDM-PDD are estimated to be 23,448 t CO_2/year. The number is adjusted to the duration of the monitoring period (19 months).

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

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The actual emission reduction achieved is increased for approximately 10 % compared to the registered PDD.
Compared to the assumed daily production rate of 12,700 m3 biogas/day, the average production during the monitoring period was 14,811 biogas/day (based on 300 operation days/year). This is partly due to the slightly increased amount of waste water flow into the digester compared to the historical values used for ex-ante calculation (12,823 m^3/month compared to 11,494 m^3/month). On the other hand the methane content averaged 50.6 compared to estimated 65% in the registered PDD. The more of biogas was also balanced by a more of flaring compared to the registered PDD, leading to higher project emissions (Assumption of flare operation time: 16 hrs/yr, e.g. 25,300 m^3 biogas /yr. The actual flaring of biogas was 887.499 m^3 biogas /yr.

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History of the document

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