Monitoring report form

(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand	
UNFCCC reference number of the project activity	2141	
Version number of the monitoring report	2.1	
Completion date of the monitoring report	22/06/2017	
Monitoring period number and duration of this monitoring period	6th monitoring period 15/09/2014 – 30/04/2016 (first and last days included)	
Project participant(s)	CYY Bio Power Co.,Ltd. South Pole Carbon Asset Management Ltd. Kommunalkredit Public Consulting GmbH	
Host Party	Thailand	
Sectoral scope(s)	Sectoral scope: 13 Waste handling and disposal	
Selected methodology(ies)	Applied methodology: AM0022 ver.4 - Avoided Wastewater and On-site Energy Use Emissions in the industrial Sector	
Selected standardized baseline(s)	Not applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	161,265	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	Not applicable	122,610

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The project activity involves the installation of an upflow anaerobic sludge blanket technology (UASB) and two gas engines at an existing starch factory for:

a) The extraction of methane (biogas) from the wastewater stream through the biogas reactor;
b) The reuse of biogas as fuel in existing thermal oil boiler within the starch plant for starch drying;
c) The reuse of biogas as fuel for power generation (using two gas engines each of 1.36 MWel capacity)

The implementation of the project activity helps in the avoidance of methane (a GHG) emissions, which would have occurred from the anaerobic decay of wastewater in the baseline. Furthermore, biogas is used as a fuel in the thermal oil boiler and in a gas engine. The use of biogas reduces GHG emissions related to fossil fuel use in the baseline in the boiler and in the grid.

Brief description of the installed technology and equipment
The following equipments have been installed in the project activity:

Component	Manufacturer	Type/Model	Brief description
Biogas reactor / Wastewater treatment system	Global Water Engineering (GWE) Ltd.,Hongkong	Upflow Anaerobic Sludge Blanket (UASB)	Upflow Anaerobic Sludge Blanket has a designed COD reduction efficiency of 90%. The UASB is designed with a total volumetric capacity of 6,000 m^3. The hydraulic retention time is approximate 2.5 days on total capacity as per design proposal provided by technology supplier.
Gas engine	DEUTZ	Biogas engine TBG 620 V16K	There are two electricity generation sets with total installed capacity of 2.72 $MW_{el.}$
Flare	DWS	Elevated biogas flare	An open flare has a maximum capacity of 1,600 Nm^3/hr as per the technology description by the supplier.

Relevant dates for the project activity

Event	Date	Reference
Construction of UASB	04/08/2006	Purchase order for civil works
Commissioning of UASB	03/11/2007	Certificate of Civil Mechanical and Electrical Completion
Commissioning of gas engines	02/12/2008 - 08/12/2008	Minutes of Commissioning by Pro2 (technology provider)
Registration under UNFCCC	25/03/2009	UNFCCC website
1st monitoring period	25/03/2009 - 02/08/2009	UNFCCC website
Approval of revision of monitoring plane	12/08/2010	UNFCCC website
Approval of notification for changes in the registered PDD	16/03/2012	UNFCCC website
2nd monitoring period	03/08/2009 - 31/12/2010	UNFCCC website
3rd monitoring period	01/01/2011 - 31/12/2012	UNFCCC website
4th monitoring period	01/01/2013 - 20/08/2013	UNFCCC website

5th monitoring period	21/08/2013 – 14/09/2014	Under verification process

Total GHG emission reductions achieved in this monitoring period are 122,610 tCO_2e.

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

A.2. Location of project activity

The project site is located in Tombol Pongdaeng, Amphur Khamtalesor, Nakorn Ratchasima Province, Thailand (Host country). The coordinates of the project are Latitude 14°59'55"N (14.9986 N) and Longitude 101°54'42"E (101.9117 E).

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Thailand (host)	CYY Bio Power Co.,Ltd. (Private entity)	No
Switzerland	South Pole Carbon Asset Management Ltd. (Private entity)	No
Austria	Kommunalkredit Public Consulting GmbH (Private entity)	No

A.4. Reference of applied methodology and standardized baseline

a) The applied methodology
AM0022 version 04 – Avoided Wastewater and On-site Energy Use Emission in the Industrial Sector (https://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_6YUZFP6D04KGQUCLY8NNMXBCE868MA/EB28_repan08_AM0022_ver04.pdf?t=dFJ8bW1xZ3B1fDAMYMKgdkBV58p5_HmUw7re)

b) Within AM0022 following tools are used for this project activity:
- "Tool to determine project emissions from flaring gases containing methane" (EB 28 annex 13) is used to calculate project emissions from flaring of a residual gas stream containing methane (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v1.pdf)
- "Tool to calculate the emission factor for an electricity system" (Version 01) is used to calculate the Carbon Emission Factor (CEF) of the electricity grid, required for determination of baseline emissions due to displacement of grid electricity. (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.pdf)

A.5. Crediting period of project activity

Type: Fixed crediting period (10 years)
Start date and end date of the crediting period: 25/03/2009 – 24/03/2019
Current monitoring period: 15/09/2014 - 30/04/2016
Length of the current monitoring period: 594 days

A.6. Contact information of responsible persons/entities

South Pole Carbon Asset Management Ltd.
registration@thesouthpolecarbon.group.com

South Pole Carbon Asset Management Ltd. is a project participant responsible for completing this CDM-MR-FORM. Please refer to Appendix 1 for detailed contact information.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project activity involves the installation of an up-flow anaerobic sludge blanket technology (UASB) to generate biogas that is used to replace fuel usage in an existing boiler within the starch plant and generate renewable electricity.

The wastewater flows from the factory into a storage lagoon. The influent first passes through a screen extractor in order to remove coarse particles. After the screening the wastewater flows into an equalization pond.

The wastewater is then pumped into the reactors through an influent distribution system at the bottom of the reactor. The methane reactors are of the UASB type. In the UASB, the wastewater rises through an expanded bed of anaerobic active methanogenic sludge (the so called "sludge blanket") and an internal device at the top of the reactor, which results in a separation of the mixed liquor into clarified wastewater, biogas and sludge. The absence of any mechanical agitation allows a natural selection towards heavy flocs of active methanogenic sludge.

Excess sludge can eventually, from time to time, be withdrawn from the bottom of the reactor. This excess sludge is extremely thick (5-10% Dissolved Solids), stable, and can be dumped without problems, but it is widely sought after to start-up new reactors elsewhere. The effluent of the anaerobic treatment is further treated in some of the existing lagoons, receiving only 2% to maximum 10% of the original COD load.

A gas storage is installed[1] at the project site in order to optimize the biogas utilization ratio by ensuring a better match between biogas generation and energy demand at the thermal oil boiler and gas engines, thus avoiding unnecessary flaring of biogas. Part of the resulting biogas is used in the factory as fuel in an existing thermal oil boiler for starch drying. A dual fuel burner able to fire oil and gas is employed to burn only biogas or both fuels mixed together. The biogas meter is equipped to record the biogas consumption of the burner.

The rest of the biogas is used as fuel in two power generators (gensets) with a total installed capacity of 2.72 MW_{el}. Before use in the power generators, the biogas has to be treated to reduce the sulphur content of the biogas from tapioca starch factory effluent using a biogas “sweetening” plant, based on a proprietary sulphur removal system, which does not use chemicals (except for pH control in the oxidation phase). In practice min. 90% removal is obtained. The scrubber is placed on top of the aeration basin, so as to allow gravitational flow of the washing water back into the inlet of the aeration basin. From the aeration basin, water is continuously pumped into the scrubber tower.

The flare system is installed on the top of the reactors. The rest of the biogas apart from utilization and collection in the gas storage is destroyed in the flare system, which is also required as part of safety procedures of the wastewater treatment plant.

The UASB system was commissioned in 2007 and the installation of two gas engines occurred later in 2008. The project activity started operation in full capacity on 29th November 2008, which is the commissioning date of the gas engines.

[1] The gas storage was constructed on 27/02/2010 during the second CDM monitoring period and was not part of the initial design of the project activity. The PDD was revised during the 2nd verification and was approved on 16/03/2012.

Implementation of the project during the monitoring period.

During the monitoring period, there were no significant events occurred which affected the project activity as describe above. The calibration of the equipment was conducted as per the monitoring procedure of the project activity. Therefore, there were no calibration delay occurred during the monitoring period.

B.2. Post-registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

No temporary deviations from registered monitoring plan or applied methodology during the monitoring period.

B.2.2. Corrections

During the monitoring period, there are no corrections to project information or parameters fixed at validation.

B.2.3. Changes to start date of crediting period

There are no changes to the start date of crediting period.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

Not applicable

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

The following changes from the registered monitoring plan were requested and approved during the 3rd monitoring period.

AM0022 ID 16: volume of flow of wastewater directly to the current wastewater treatment system and bypassing the new wastewater treatment facility

This parameter was removed from the registered monitoring plan since it had no direct or indirect impact on the estimation of emission reductions.

The revision of the monitoring plan was approved on 12/08/2010.
(https://cdm.unfccc.int/Projects/DB/RWTUV1218617500.62/view)

There is no change in monitoring plan during the current monitoring period.

B.2.6. Changes to project design of registered project activity

The gas storage was installed in 2010 which was not part of the initial design of the project activity.

The approval date of the revised PDD: 16/03/2012

The version and completion date of the revised PDD: version 4.1 and dated 31/01/2012

There is no change in project design during the current monitoring period.

B.2.7. Types of changes specific to afforestation or reforestation project activity

The project activity is not affectation or reforestation. Therefore, the section is not applicable to the project activity.

SECTION C. Description of monitoring system

Data Management and Emission Reduction Reporting:

The data management is done in the following manner.

- Data acquisition from gas meters of flare and gas engines and waste water flow meter is executed through the process control unit on daily basis and the values are input manually into the CDM monitoring sheets by the plant staff and electronic format by the head of QC.
- Data acquisition from gas meter at boiler is recorded on daily basis by the staff of starch factory. The copied data is submitted to and kept by the head of QC. The values are transferred to electronic log sheet by the head of QC.
- Electricity generation is recorded manually in daily operation sheets on daily basis at the control unit of the gas engines and transferred to electronic log sheet.
- Methane concentration is executed through the process control unit. The average values are done and input manually into the operation log book and transferred to electronic log sheet.
- For laboratory monitored parameters, the records are written into the log sheets on daily basis and transferred to electronic log sheet.
- The values from electronic log sheet are used for calculation of emission reductions estimation.
- The data is backed up in the form of excel sheet formats on a different computer and also on a portable storage system such as compact disc every 4 months by the head of QC.
- The data is archived for a period of 2 years after the crediting period.

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 excel report templates, which are used for calculation of emission reductions and monthly reporting respectively. The head of QC team sends the printout of summary monthly report to the plant manager and the managing director. The compiled excel report is further sent to the project consultant for detailed emission reduction analysis. The managing director and project consultant interact at least once in three months 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.

QA/QC Procedures:

- The calibrations for all the monitoring devices are available, relevant to the monitoring period.
- The head of QC ensures the timely calibrations of the monitoring devices, data acquisition and storage of data.
- The roles and responsibilities of the project's staff are briefly tabulated below.

Roles	Responsibilities
Head of Quality Control	Checks the completeness of the parameters monitored Calculates and inserts the data of methane concentration into the log book Provides the monthly report Sends the monthly report in print format to the plant manager and managing director Sends aggregated reports via email to the project consultant monthly basis

	Transfers all of the parameters monitored in log books into the electronic log file (excel report) on daily basis Cooperates with the head of instrumentation to ensure the timely calibrations of the monitoring equipment Backs up the data from the excel reports every 4 months Follows and collects the copied log book for the monitored parameter at the boiler of the starch plant on daily basis
Quality Control Staff	- Takes samples and analyzes characteristics of wastewater - Fills in the analysis result to the log book
Biogas system controller	- Fills in the data monitored for biogas system from the process control unit to the log book
Power system controller	- Fills in the data monitored for power system from the process control unit to the log book
Plant Manager	- Supervises and signs off the monthly report
Head of Instrumentation (Technician)	- Supports the operation of biogas and power system - Maintains and repairs the equipment and machines - Cooperates with the head of quality control to ensure the timely calibrations of the monitoring equipment

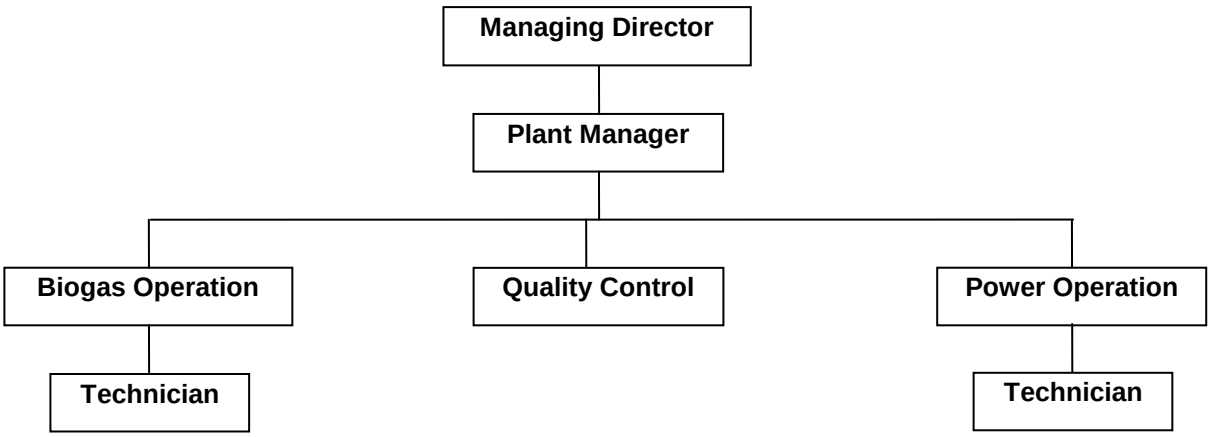

Figure 1: Organization chart

Emergency procedures for the monitoring system

The daily checklist for operation is done on a daily basis by the staff in charge of overall checking the operation. The staff of next shift shall be made aware of any event from the previous day or previous shift and plan to promptly handle the situation. In case of problem in any equipment or machine, the staff shall inform the project owner or the technical consultants to project for quick rectification of the problem.

Monitoring equipment of the project activity

Parameter Notation				Monitoring equipment	Serial no.	Parameter Description
AM0022	**Registered PDD**	**SCADA representation**	**Tag no.**			
ID1	FM1	FT100	PD-MM-001	Wastewater flow meter	A0642633	Wastewater flows entering the project treatment facility.
ID2[2]	n/a	n/a	n/a	n/a	n/a	Wastewater flow leaving the project treatment facility
ID3	n/a	n/a	PD-CL-001	Portable colorimeter	070890C64902	COD concentration of the wastewater entering the new anaerobic digestion system
ID4	n/a	n/a	PD-CL-001	Portable colorimeter	070890C64902	COD concentration of the wastewater leaving the new anaerobic digestion system.
ID5	GM3	FT501	PD-DM-003	Gas Flow meter	91FA19282639[3] C140397[4]	Volume of biogas sent to facility heaters
ID7	PM-A PM-B	n/a	PD-PM-001 PD-PM-002	Power meter	A: A010393 B: A004997	Electricity generated from collected biogas
ID8[5]	n/a	n/a	n/a	n/a	n/a	Fossil fuel volume equivalent to generate same amount of heat generated from the biogas collected
ID9	GM2	FT105	PD-DM-002	Gas Flow meter	265DS6600065941	Biogas sent to flare
ID10	GM4	FT501A, FT501B	PD-DM-004 PD-DM-005	Gas Flow meter	FT501A: 265DS6600032493 FT501B: 265DS6600028459	Biogas sent to genset
ID11	n/a	AIT101	n/a	CH4 analyzer	ARBM-0023	Methane content in biogas
ID13	n/a	n/a	PD-CL-001	Portable colorimeter	070890C64902	Amount of chemical oxidising agents entering system boundary
ID14[6]	n/a	n/a	n/a	n/a	n/a	Gen set combustion efficiency (combustion of methane)
ID15[4]	n/a	n/a	n/a	n/a	n/a	Heating system combustion efficiency (combustion of methane

[2] There is revision of monitoring plan for this parameter, which was approved on 12/08/2010. This parameter is referred to be established using ID1 and hydrological balance assumed. Therefore, in the actual implementation is not required to install a flow meter at the outlet of the project treatment facility.

[3] Period of use: beginning – 30/07/2014

[4] Period of use: 31/07/2014 - present

[5] Calculated value

[6] Measurement of the parameter is done by third party.

ID17	n/a	n/a	PD-GD-001	Gas detector	10110R4-006	Loss of biogas from pipeline
ID18	n/a	n/a	n/a	Weigh bridge	0000237	Organic material removed from wastewater facility
ID19[3]	n/a	n/a	n/a	n/a	n/a	Biogas calorific value

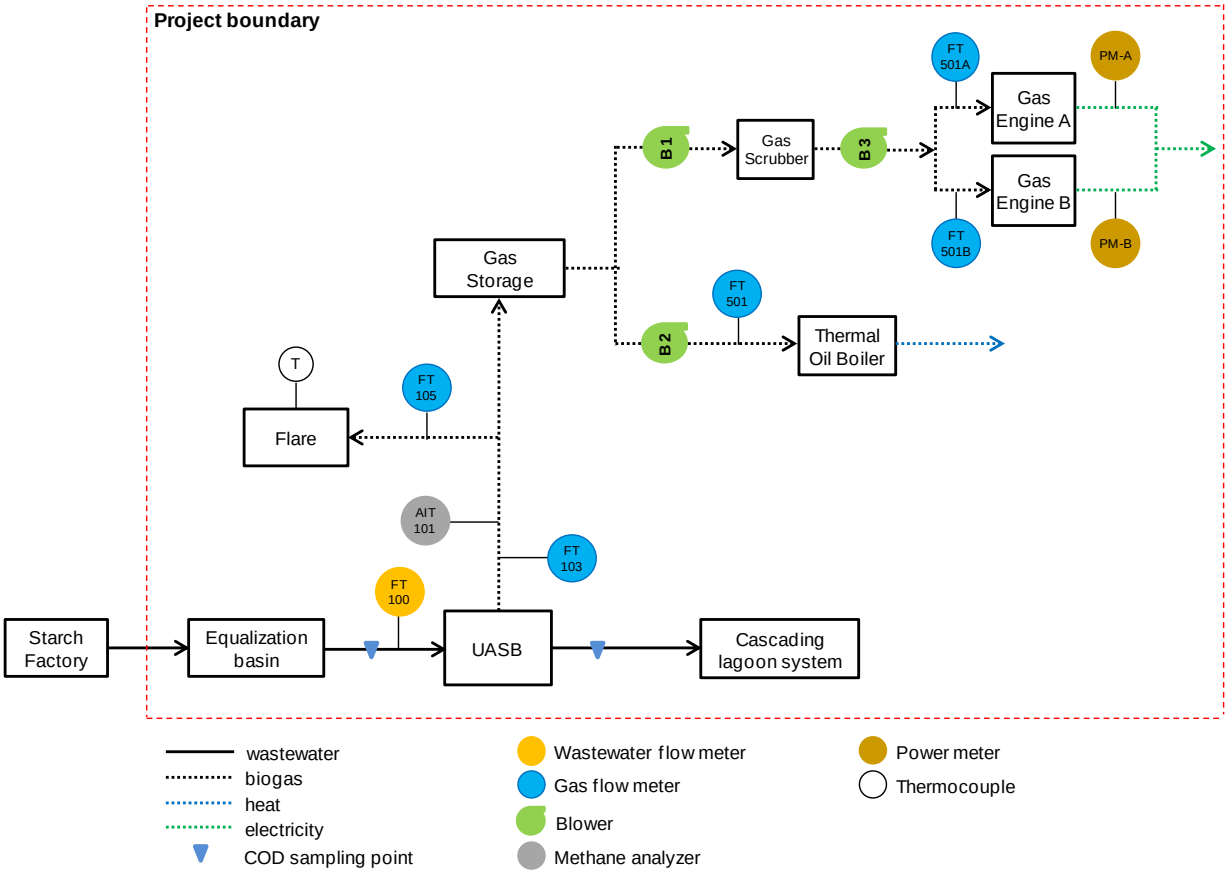

Figure 2: Flow diagram of the project activity representing the actual set-up of the monitoring system after approval of the monitoring plan revision

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/parameter:	**EF_{CH4}**
Unit	kg CH_4/ kg COD
Description	Methane emission factor
Source of data	Estimated based on IPDD default value and available scientific literature
Value(s) applied)	0.21
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions
Additional comments	n/a

Data/parameter:	R_{lagoon}
Unit	%
Description	Organic material removal ratio
Source of data	Chemical analysis of effluent samples at inlet and outlet of lagoon system boundaries
Value(s) applied)	98.90
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions
Additional comments	

Data/parameter:	**Surface Aerobic Losses Factor**
Unit	kg COD/ ha/ day
Description	Surface aerobic losses factor per hectare of pond surface area per day
Source of data	Default value AM0022, Version 04
Value(s) applied)	254 kg COD/ ha/ day
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions
Additional comments	

Data/parameter:	**Chemical Oxidation Losses Factor**
Unit	kg COD/ m^3
Description	Chemical oxidation losses factor per cubic meter of effluent entering the lagoon based treatment system
Source of data	Default value AM0022, Version 04
Value(s) applied)	0.07587 * 0.651 = 0.0494 kg COD/ m^3
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions
Additional comments	n/a

Data/parameter:	$R_{deposition}$
Unit	%
Description	Organic material deposition ratio
Source of data	Project developer
Value(s) applied)	7.05
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline and project emissions.
Additional comments	

Data/parameter:	E_{CH4_NAWTF}
Unit	%
Description	Proportion of methane emitted from UASB digesters
Source of data	Information provided by technology provider
Value(s) applied)	1
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comments	n/a

Data/parameter:	f_{boiler}
Unit	%
Description	Proportion of biogas destroyed by combustion in the boilers used for heat generation.
Source of data	Technical literature
Value(s) applied)	98.5
Choice of data or measurement methods and procedures	This value is based on technical literature and manufacturer's specifications of similar boilers. The factor is assumed to conservative given the fact that the oxidation default value used for gaseous fuels in the 1996 IPCC Guidelines for National GHG Inventories was 100%.
Purpose of data	Calculation of project emissions
Additional comments	n/a

Data/parameter:	f_{engine}
Unit	%
Description	Proportion of biogas destroyed by combustion in the boilers used for electricity generation.
Source of data	Technical literature
Value(s) applied)	99
Choice of data or measurement methods and procedures	This value is based on technical literature and manufacturer's specifications of similar boilers. The factor is assumed to conservative given the fact that the oxidation default value used for gaseous fuels in the 1996 IPCC Guidelines for National GHG Inventories was 100%.
Purpose of data	Calculation of project emissions
Additional comments	n/a

Data/parameter:	CEF
Unit	tCO_2/ MWh
Description	Carbon emission factor for the electricity displaced by the electricity generated from the biogas
Source of data	Electricity Generation Authority of Thailand (EGAT), "Tool to calculate the emission factor for an electricity system"
Value(s) applied)	0.52
Choice of data or measurement methods and procedures	CEF is calculated according to the "Tool to calculate the emission factor for an electricity system" as determined in the respective small-scale methodology for grid connected electricity generation (AMS-I.D v.13).

Purpose of data	Calculation of baseline emissions
Additional comments	n/a

Data/parameter:	**EF**
Unit	tCO_2/ TJ
Description	Carbon emission factor of heavy fuel oil
Source of data	2006 IPCC guidelines for National GHG Inventories
Value(s) applied)	77.40
Choice of data or measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions
Additional comments	n/a

Data/parameter:	**NCV**
Unit	TJ/ t
Description	Net calorific value of heavy fuel oil
Source of data	2006 IPCC guidelines for National GHG Inventories
Value(s) applied)	0.0404
Choice of data or measurement methods and procedures	Default value
Purpose of data	Calculation of baseline emissions
Additional comments	n/a

Data/parameter:	**Density of CH_4**
Unit	$kgCH_4$/ Nm^3 CH_4
Description	Density of methane at standard condition (0 degree Celsius, 1,013 bar)
Source of data	UNFCCC Methodological tool to determine project emissions from flaring gases containing methane, Table 1, page 12
Value(s) applied)	0.716
Choice of data or measurement methods and procedures	Default value
Purpose of data	Calculation of baseline and project emissions
Additional comments	n/a

Data/parameter:	**Lagoon surface area**
Unit	Hectare
Description	Total lagoon area
Source of data	Project owner
Value(s) applied)	25.18
Choice of data or measurement methods and procedures	-

Purpose of data	Calculation of baseline and project emissions
Additional comments	

Data/parameter:	**Flare efficiency**
Unit	%
Description	Flare efficiency for open flare
Source of data	Tool to determine project emissions from flaring gases containing methane
Value(s) applied)	0% if the flame is not detected for more than 20 minutes during the hour h. 50%, if the flame is detected for more than 20 minutes during the hour h.
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comments	n/a

Data/parameter:	**Specific heavy fuel oil consumption**
Unit	t HFO/t starch
Description	Historic average heavy fuel oil consumption per ton of output (ton of dry starch)
Source of data	Historic fuel consumption of 2006/2007
Value(s) applied)	0.033
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comments	n/a

Data/parameter:	**Specific electricity consumption**
Unit	MWh/t starch
Description	Historic average electricity consumption per ton of output (ton of dry starch)
Source of data	Historic electricity consumption of 2006/2007
Value(s) applied)	0.222
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions
Additional comments	n/a

D.2. Data and parameters monitored

Data/parameter:	**AM0022 ID 1** **Wastewater flows entering the project treatment facility**
Unit	m^3
Description	Wastewater flow entering into the new anaerobic digestion system

<table>
<tr><td>Measured/calculated/default</td><td>Measured continuously by the flow meter

In the CDM Monitoring Sheet, the data in m3/day can be done by the following
Data in day ‘x’ = (totalizer in day ‘x’) - (totalizer in day ‘x-1’)</td></tr>
<tr><td>Source of data</td><td>Log sheet</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Total value (m^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>191,981</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>926,098</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>284,429</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>SCADA representation / Tag no.</td><td>FT100 / PD-MM-001</td></tr>
<tr><td>Equipment Type</td><td>Electromagnetic flowmeter with flow converter</td></tr>
<tr><td>Manufacturer</td><td>Krohne</td></tr>
<tr><td>Model</td><td>IFC010D</td></tr>
<tr><td>Maximum permissible error</td><td>±0.3%</td></tr>
<tr><td>Serial No.</td><td>A0642633</td></tr>
<tr><td>Calibration Frequency</td><td>Annually</td></tr>
<tr><td>Date of previous calibration</td><td>27/09/2013
25/09/2014</td></tr>
<tr><td>Date of latest calibration</td><td>25/08/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>The meter has continuous monitoring of the flow of wastewater. The accumulated reading shall be taken from the SCADA screen and logged into the electronic file by the operator on a daily basis.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>n/a</td></tr>
<tr><td>QA/QC procedures:</td><td>Flow meter is undergone maintenance / calibration subject according to appropriate industry standards.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline and project emissions</td></tr>
<tr><td>Additional comments:</td><td></td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>AM0022 ID 2
Wastewater flows leaving the project treatment facility</td></tr>
<tr><td>Unit</td><td>m^3</td></tr>
<tr><td>Description</td><td>Wastewater flow leaving the new anaerobic digestion system</td></tr>
<tr><td>Measured/calculated/default</td><td>Established using ID 1 and assuming hydrological balance</td></tr>
<tr><td>Source of data</td><td>Established using ID 1 and assuming hydrological balance</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Total value (m^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>191,981</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>926,098</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>284,429</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Refer to the information provider for ID 1</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Refer to the information provider for ID 1</td></tr>
<tr><td>Calculation method (if applicable):</td><td>Refer to the information provider for ID 1</td></tr>
<tr><td>QA/QC procedures:</td><td>Refer to the information provider for ID 1</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline and project emissions</td></tr>
<tr><td>Additional comments:</td><td></td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>AM0022 ID 3
Wastewater organic material concentration entering the project treatment facility</td></tr>
<tr><td>Unit</td><td>kg COD/ m^3</td></tr>
<tr><td>Description</td><td>COD concentration of the wastewater entering the new anaerobic digester system</td></tr>
<tr><td>Measured/calculated/default</td><td>The test shall be done and recorded in mg/l by the quality control staff. The value is later converted to kg COD/ m^3</td></tr>
<tr><td>Source of data</td><td>Log sheet</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Average value (kg COD/m^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>24.64</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>19.78</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>24.54</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>SCADA representation / Tag no.</td><td>n/a / PD-CL-001</td></tr>
<tr><td>Equipment Type</td><td>Portable Colorimeter</td></tr>
<tr><td>Manufacturer</td><td>Hach</td></tr>
<tr><td>Model</td><td>DR/890</td></tr>
<tr><td>Maximum permissible error</td><td>±0.24%</td></tr>
<tr><td>Serial No.</td><td>070890C64902</td></tr>
<tr><td>Calibration Frequency</td><td>Annually</td></tr>
<tr><td>Date of previous calibration</td><td>21/10/2013
03/10/2014</td></tr>
<tr><td>Date of latest calibration</td><td>03/09/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>Composite sampling is taken and the analysis is performed on a daily basis. This procedure is followed during the monitoring period.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>The daily COD data in kg COD/m^3 is multiplied by the daily wastewater flow to estimate the COD load on a daily basis. The approach is transparently applied in the excel sheet.</td></tr>
<tr><td>QA/QC procedures:</td><td>Periodic test is carried out by an accredited laboratory/company in order to provide quality assurance.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of baseline and project emissions</td></tr>
<tr><td>Additional comments:</td><td></td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>AM0022 ID 4
Wastewater organic material concentration leaving the project treatment facility</td></tr>
<tr><td>Unit</td><td>kg COD/ m^3</td></tr>
<tr><td>Description</td><td>COD concentration of the wastewater leaving the new anaerobic digester system</td></tr>
<tr><td>Measured/calculated/default</td><td>The test shall be done and recorded in mg/l by the quality control staff. The value is later converted to kg COD/ m^3</td></tr>
<tr><td>Source of data</td><td>Log sheet</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Average value (kg COD/m^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>2.11</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>2.26</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>2.63</td></tr>
</table>
</td></tr>
</table>

Monitoring equipment	

SCADA representation / Tag no.	n/a / PD-CL-001
Equipment Type	Portable Colorimeter
Manufacturer	Hach
Model	DR/890
Maximum permissible error	±0.24%
Serial No.	070890C64902
Calibration Frequency	Annually
Date of previous calibration	21/10/2013 03/10/2014
Date of latest calibration	03/09/3015

Measuring/reading/recording frequency:	Composite sampling is taken and the analysis is performed on a daily basis. This procedure is followed during the monitoring period.
Calculation method (if applicable):	The daily COD data in kg COD/m^3 is multiplied by the daily wastewater flow to estimate the COD load on a daily basis. The approach is transparently applied in the excel sheet.
QA/QC procedures:	Periodic test is carried out by an accredited laboratory/company in order to provide quality assurance.
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	

Data/parameter:	**AM022 ID 5** **Volume of biogas sent to facility heaters**
Unit	Nm^3 biogas
Description	Volume of biogas sent to facility heaters
Measured/calculated/default	Measured continuously (normalized to take into account pressure and temperature) by gas flow meters
Source of data	Boiler Log sheet
Value(s) of monitored parameter	

Monitoring period	**Total value (Nm^3)**
15/09/2014 – 31/12/2014	1,236,730
01/01/2015 – 31/12/2015	4,330,527
01/01/2016 – 30/04/2016	1,663,279

Monitoring equipment	

Representation / Tag no.	**FT501 / PD-DM-003**

Period of use	**31/07/2014 - present**
Equipment Type	Differential flow meter
Manufacturer	Binder
Model	E7A-S100000-1MA200-D1104501-21CS2410
Maximum permissible error	±0.04%
Serial No.	C140397
Calibration Frequency	Annually
Date of previous calibration	27/08/2014
Date of latest calibration	25/09/2014 and 25th August 2015

Measuring/reading/recording frequency:	The meter has continuous monitoring of the biogas flow sent to boiler. The meter readings are taken and logged in the electronic file by the operator on a daily basis.
Calculation method (if applicable):	n/a

QA/QC procedures:	Gas flow meter is undergone maintenance / calibration subject to appropriate industry standards. In case of technical problems with the meter, value can be calculated based on a mass balance using the other installed gas meters (biogas sent to heaters = total biogas produced – biogas sent to flare – biogas sent to engine). However, this approach was not applied during the monitoring period since there were no problems with the meter.
Purpose of data:	Calculation of baseline emissions
Additional comments:	

Data/parameter:	**AM0022 ID 7** **Electricity generated from collected biogas**
Unit	MWh
Description	Electricity generated from the biogas collected in the anaerobic treatment facility and consumed on site or sent to the grid
Measured/calculated/default	Measured continuously in kWh
Source of data	Log sheet
Value(s) of monitored parameter	

Monitoring period	Total value (MWh)
15/09/2014 – 31/12/2014	1,203.39
01/01/2015 – 31/12/2015	1,651.10
01/01/2016 – 30/04/2016	104

Monitoring equipment

Location	Generator A
SCADA representation / Tag no.	n/a / PD-PM-001
Equipment Type	Power meter
Manufacturer	DEIF
Model	Multi – Line PPU/2/GS
Maximum permissible error	Class 1.0, ±1.00%
Serial No.	A010393
Calibration Frequency	Annually
Date of previous calibration	12/10/2013 27/09/2014
Date of latest calibration	17/07/2015

Location	Generator B
SCADA representation / Tag no.	n/a / PD-PM-002
Equipment Type	Power meter
Manufacturer	DEIF
Model	Multi – Line PPU/2/GS
Maximum permissible error	Class 1.0, ±1.00%
Serial No.	A004997
Calibration Frequency	Annually
Date of previous calibration	12/10/2013 27/09/2014
Date of latest calibration	17/07/2015

The COD (Commercial Operation Date) was on 27/11/2015. Therefore, from 27/11/2015 onwards, the data shall be measured by the electricity meter of PEA (Provincial Electricity Authority) and referred to the monthly reading report issued by PEA.

Equipment Type	Power meter - export
Manufacturer	EDMI
Model	Genius Series Mk6N
Maximum permissible error	Class 0.5s, ±0.5%
Serial No.	212606672

Equipment Type	Power meter - import
Manufacturer	EDMI
Model	Genius Series Mk6N
Maximum permissible error	Class 0.5s, ±0.5%
Serial No.	206500531

Measuring/reading/recording frequency:

PD-PM-001 and PD-PM-002 (internal meters used before exporting to grid or COD)
The equipment has continuous monitoring of the electricity generated. The accumulated reading shall be taken from the meter in the generator room and recorded in the log sheet by the operator on a daily basis.

PEA power meter
The electricity exported shall be continuously measured using power meter installed and owned by PEA. The readings shall be based on monthly joint meter readings between PEA and project representative.

Calculation method (if applicable):

n/a

QA/QC procedures:

PD-PM-001 and PD-PM-002 (internal meters used before exporting to grid or COD)
Electricity meters would undergo maintenance / calibration subject to appropriate industry standards.

PEA power meter
The calibration of the meter is under the control of the PEA.

Purpose of data:	Calculation of project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 8** **Fossil fuel volume equivalent to generate same amount of heat generated from the biogas collected in the anaerobic treatment facility**
Unit	m^3
Description	Fossil fuel volume equivalent to generate same amount of heat generated from the biogas collected in the anaerobic treatment facility
Measured/calculated/default	Calculated
Source of data	Value in m^3 unit Calculated based on amount of biogas sent to the boiler (ID 5), 0.5743 kg of HFO/m^3 biogas (referred to section B.6.1 of the registered PDD) and heavy fuel density of 0.995 kg/l (referred to section B.6.1 of the registered PDD). Value in ton unit Calculated based on amount of biogas sent to the boiler (ID 5), NCV of heavy fuel oil and NCV of biogas. As per page 27 of the registered PDD, the above value needs to be compared with historical average of 0.03303 tHFO/t dry starch.
Value(s) of monitored parameter	**Monitoring period** / **Total value (tons)** 15/09/2014 – 31/12/2014: 703.17 01/01/2015 – 31/12/2015: 2,187.85 01/01/2016 – 30/04/2016: 840.90 Note: The above value is a conservative value based on comparison between fossil fuel amount calculated based on biogas equivalent and the historical value of 0.03303 tHFO/ t dry starch. Further, the amount of fossil fuel consumed during the monitoring period is deducted to be even further conservative. The detail can be found in the calculation sheet.
Monitoring equipment	The calculation of this parameter is based on the amount of biogas sent to the boiler which is measured by using the same equipment as ID 5
Measuring/reading/recording frequency:	The calculation for the data is done on a daily basis. The approach is transparently applied in the excel sheet.
Calculation method (if applicable):	The quantity of biogas used at boiler is multiplied by 0.5743. Then divided by the density of heavy fuel oil to get the volume of heavy fuel oil in m^3. The quantity of biogas used at boiler is multiplied by NCV of biogas. Then divided by NCV of heavy fuel oil to get the volume of heavy fuel oil in ton.
QA/QC procedures:	n/a
Purpose of data:	The data in term of ton unit is used for calculation of baseline emissions
Additional comments:	

Data/parameter:	**AM0022 ID 9** **Biogas sent to flares (V1)**
Unit	Nm^3 biogas
Description	Surplus biogas sent to flare system (dry basis)

<table>
<tr><td>Measured/calculated/default</td><td>Measured continuously (normalized to take into account pressure temperature) by gas flow meters.

In the CDM Monitoring Sheet, the data in Nm3/day can be done by the following

Data in day ‘x’ = (totalizer in day ‘x’) - (totalizer in day ‘x-1’)</td></tr>
<tr><td>Source of data</td><td>Log sheet</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Total value (Nm^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>94</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>727</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>SCADA representation / Tag no.</td><td>FT105 / PD-DM-002</td></tr>
<tr><td>Equipment Type</td><td>Differential flow meter</td></tr>
<tr><td>Manufacturer</td><td>ABB</td></tr>
<tr><td>Model</td><td>265DS CCFA6B1</td></tr>
<tr><td>Maximum permissible error</td><td>±0.04%</td></tr>
<tr><td>Serial No.</td><td>265DS6600065941</td></tr>
<tr><td>Calibration Frequency</td><td>Annually</td></tr>
<tr><td>Date of previous calibration</td><td>27/09/2013
25/09/2014</td></tr>
<tr><td>Date of latest calibration</td><td>25/08/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>The meter has continuous monitoring of the biogas flow sent to flare system. The accumulated reading shall be taken from the SCADA screen and logged into the electronic file by the operator on a daily basis.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>n/a</td></tr>
<tr><td>QA/QC procedures:</td><td>Flow meter is undergone maintenance / calibration subject to appropriate industry standards. In case of technical problems with the meter, value can be calculated based on a mass balance using the other installed gas meters (biogas sent to flare = total biogas produced – biogas sent to boiler – biogas sent to engines).

However, this approach was not applied during the monitoring period since there were no problems with the meter.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td></td></tr>
</table>

Data/parameter:	**AM0022 ID 10** **Biogas sent to generation**
Unit	Nm^3 biogas
Description	Biogas sent to generation facility and used for electricity generation
Measured/calculated/default	Measured continuously (normalized to take into account pressure temperature) by gas flow meters. In the CDM Monitoring Sheet, the data in Nm3/day can be done by the following Data in day ‘x’ = (totalizer in day ‘x’) - (totalizer in day ‘x-1’)
Source of data	Log sheet

<table>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Total value (Nm^3)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>549,937</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>1,140,824</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>228,486</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><td>Location</td><td>Generator A</td></tr>
<tr><td>SCADA representation / Tag no.</td><td>FT501A / PD-DM-004</td></tr>
<tr><td>Equipment Type</td><td>Differential flow meter</td></tr>
<tr><td>Manufacturer</td><td>ABB</td></tr>
<tr><td>Model</td><td>265DS CCFA6B1</td></tr>
<tr><td>Maximum permissible error</td><td>±0.04%</td></tr>
<tr><td>Serial No.</td><td>265DS6600032493</td></tr>
<tr><td>Calibration Frequency</td><td>Annually</td></tr>
<tr><td>Date of previous calibration</td><td>27/09/2013
25/09/2014</td></tr>
<tr><td>Date of latest calibration</td><td>25/08/2015</td></tr>
</table>
<table>
<tr><td>Location</td><td>Generator B</td></tr>
<tr><td>SCADA representation / Tag no.</td><td>FT501B / PD-DM-005</td></tr>
<tr><td>Equipment Type</td><td>Differential flow meter</td></tr>
<tr><td>Manufacturer</td><td>ABB</td></tr>
<tr><td>Model</td><td>265DS CCFA6B1</td></tr>
<tr><td>Maximum permissible error</td><td>±0.04%</td></tr>
<tr><td>Serial No.</td><td>265DS6600028459</td></tr>
<tr><td>Calibration Frequency</td><td>Annually</td></tr>
<tr><td>Date of previous calibration</td><td>27/09/2013
25/09/2014</td></tr>
<tr><td>Date of latest calibration</td><td>25/08/2015</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>The meters have continuous monitoring of the biogas flow sent to generation facility. The accumulated reading shall be taken from the SCADA screen and logged into the electronic file by the operator on a daily basis.</td></tr>
<tr><td>Calculation method (if applicable):</td><td>n/a</td></tr>
<tr><td>QA/QC procedures:</td><td>Flow meters are undergone maintenance / calibration subject to appropriate industry standards.</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td></td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>AM0022 ID11
Biogas methane concentration</td></tr>
<tr><td>Unit</td><td>%</td></tr>
<tr><td>Description</td><td>Methane concentration in biogas</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured continuously.
The average of data is done for representing the data of the day</td></tr>
<tr><td>Source of data</td><td>Log sheet</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Monitoring period</th><th>Average value (%)</th></tr>
<tr><td>15/09/2014 – 31/12/2014</td><td>68.97</td></tr>
<tr><td>01/01/2015 – 31/12/2015</td><td>69.83</td></tr>
<tr><td>01/01/2016 – 30/04/2016</td><td>69.54</td></tr>
</table>
</td></tr>
</table>

Monitoring equipment	<table><tr><td>SCADA representation / Tag no.</td><td>AIT101 / n/a</td></tr><tr><td>Equipment Type</td><td>CH4 Analyzer</td></tr><tr><td>Manufacturer</td><td>Drager</td></tr><tr><td>Model</td><td>Polytron IR EX</td></tr><tr><td>Maximum permissible error</td><td>±1.00%</td></tr><tr><td>Serial No.</td><td>ARBM-0023</td></tr><tr><td>Calibration Frequency</td><td>Annually</td></tr><tr><td>Date of previous calibration</td><td>20/10/2013 01/10/2014</td></tr><tr><td>Date of latest calibration</td><td>23/08/2015</td></tr></table>
Measuring/reading/recording frequency:	Percentage of methane in gas is monitored continuously. The readings shall be taken from the SCADA screen and recorded in the log book on a daily basis which the averaged value shall be transferred to the electronic file by the operator.
Calculation method (if applicable):	n/a
QA/QC procedures:	The gas analyzer is undergone maintenance / calibration subject to appropriate industry standards.
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 12** **Project emissions from flaring of the residual gas stream (PE_{flare})**
Unit	t CO_2e
Description	Project emissions from flaring of the residual gas stream
Measured/calculated/default	Calculated based on amount of biogas sent to the flare (ID 9), the flare efficiency, the methane concentration of biogas (ID 11), density of methane and GWP_{CH4}
Source of data	Calculation
Value(s) of monitored parameter	<table><tr><th>Monitoring period</th><th>Total value (t CO_2e)</th></tr><tr><td>15/09/2014 – 31/12/2014</td><td>1</td></tr><tr><td>01/01/2015 – 31/12/2015</td><td>9</td></tr><tr><td>01/01/2016 – 30/04/2016</td><td>0</td></tr></table>
Monitoring equipment	The monitoring equipment for the amount of biogas sent to the flare is same as ID 9 The monitoring equipment for the methane concentration of biogas is same as ID 11
Measuring/reading/recording frequency:	The calculation for the data is done on a daily basis. The approach is transparently applied in the excel sheet.
Calculation method (if applicable):	The parameter is calculated according to the "Tool to determine project emissions from flaring gases containing methane", step 7 which the mass flow rate of methane in the residual gas ($TM_{RG,h}$) is calculated from ID 9, ID 11 and the density of methane.
QA/QC procedures:	n/a
Purpose of data:	Calculation of project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 13** **Amount of chemical oxidizing agents entering system boundary**
Unit	tonnes/m^3

Description	Amount of chemical oxidizing agents entering system boundary
Measured/calculated/default	Measured by the quality control operator The highest value is applied in the calculation for conservativeness.
Source of data	Log sheet
Value(s) of monitored parameter	**Monitoring period** / **Average value (tonnes/m^3)** 15/09/2014 – 31/12/2014 / 0.000225 01/01/2015 – 31/12/2015 / 0.000323 01/01/2016 – 30/04/2016 / 0.000557
Monitoring equipment	SCADA representation / Tag no.: - / PD-CL-001 Equipment Type: Portable Colorimeter Manufacturer: Hach Model: DR/890 Maximum permissible error: ±0.24% Serial No.: 070890C64902 Calibration Frequency: Annually Date of previous calibration: 21/10/2013 Date of latest calibration: 03/10/2014 03/09/2015
Measuring/reading/recording frequency:	Daily test for waste water samples are carried out to determine the amount of oxidising agent entering the wastewater system. The daily test result is recorded in the log sheet on a daily basis
Calculation method (if applicable):	n/a
QA/QC procedures:	Regular samples are tested for concentration of oxidising agents where they are identified as being likely to be present in wastewater when they are part of the process.
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 14** **Gen set combustion efficiency (f)**
Unit	%
Description	Proportion of biogas combusted by generation facility
Measured/calculated/default	Measured and calculated by the project developer or the default value in the registered PDD can be used. The lowest value is applied in the project emission calculation for conservativeness.
Source of data	Reports by third party or the registered PDD
Value(s) of monitored parameter	**Year** / **Measured value (%)** (Generator A / Generator B) 2014 / 99.9857% / 99.9746% 2015 / 99.9948% / 99.9943% 2016 / 99.9976% / 99.9929%

<table>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th colspan="3">Generator A</th></tr>
<tr><th>Year</th><th>Date of measurement</th><th>Done by</th></tr>
<tr><td>2014</td><td>18/02/2014</td><td rowspan="3">United Analyst and Engineering Consultant Co.,Ltd.</td></tr>
<tr><td>2015</td><td>17/08/2015</td></tr>
<tr><td>2016</td><td>17/03/2016</td></tr>
</table>
<table>
<tr><th colspan="3">Generator B</th></tr>
<tr><th>Year</th><th>Date of measurement</th><th>Done by</th></tr>
<tr><td>2014</td><td>20/02/2014</td><td rowspan="3">United Analyst and Engineering Consultant Co.,Ltd.</td></tr>
<tr><td>2015</td><td>17/08/2015</td></tr>
<tr><td>2016</td><td>17/03/2016</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>The measurement is conducted once a year</td></tr>
<tr><td>Calculation method (if applicable):</td><td>The reports are shown the result in ppm unit.
The value of the combustion efficiency is as follows
- conversion of unit from ppm to percentage of non-combusted methane and;
- the figure is deducted from 100% to determine the combustion efficiency of the generators during the monitoring period.</td></tr>
<tr><td>QA/QC procedures:</td><td>Measurements to be conducted on the basis of standard industry practice</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
<tr><td>Additional comments:</td><td>For this monitoring period the default value of 99% as per the registered PDD is applied in the calculation of emission reductions for the sake of conservativeness.</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>AM0022 ID 15
Heating system combustion efficiency</td></tr>
<tr><td>Unit</td><td>%</td></tr>
<tr><td>Description</td><td>Combustion efficiency of boilers using biogas for heat generation</td></tr>
<tr><td>Measured/calculated/default</td><td>Measured and calculated by the project developer or the default value in the registered PDD can be used.

The lowest value is applied in the project emission calculation for conservativeness.</td></tr>
<tr><td>Source of data</td><td>Reports by third party or the registered PDD</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>
<table>
<tr><th>Year</th><th>Measured value (%)</th></tr>
<tr><td>2014</td><td>99.9997%</td></tr>
<tr><td>2015</td><td>99.9954%</td></tr>
<tr><td>2016</td><td>99.9930%</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>
<table>
<tr><th>Year</th><th>Date of measurement</th><th>Done by</th></tr>
<tr><td>2014</td><td>18/02/2014</td><td rowspan="3">United Analyst and Engineering Consultant Co.,Ltd.</td></tr>
<tr><td>2015</td><td>18/08/2015</td></tr>
<tr><td>2016</td><td>16/03/2016</td></tr>
</table>
</td></tr>
<tr><td>Measuring/reading/recording frequency:</td><td>The measurement is conducted once a year</td></tr>
<tr><td>Calculation method (if applicable):</td><td>The reports are shown the result in ppm unit.
The value of the combustion efficiency is as follows
- conversion of unit from ppm to percentage of non-combusted methane and;
- the figure is deducted from 100% to determine the combustion efficiency of the generators during the monitoring period.</td></tr>
<tr><td>QA/QC procedures:</td><td>Measurements to be conducted on the basis of standard industry practice</td></tr>
<tr><td>Purpose of data:</td><td>Calculation of project emissions</td></tr>
</table>

Additional comments:	For this monitoring period the default value of 98.5% as per the registered PDD is applied in the calculation of emission reductions for the sake of conservativeness.

Data/parameter:	**AM0022 ID 16** Flow of wastewater directly to the current wastewater treatment system
Unit	m3
Description	Volume of flow of wastewater directly to the current wastewater treatment system and bypassing the new wastewater treatment facility
Measured/calculated/default	Measured continuously by the flow meter In the CDM Monitoring Sheet, the data in m3/day can be done by the following Data in day 'x' = (totalizer in day 'x') - (totalizer in day 'x-1')
Source of data	Log sheet
Value(s) of monitored parameter	**Monitoring period** / **Total value (m^3)** 15/09/2014 – 31/12/2014 / 0 01/01/2015 – 31/12/2015 / 0 01/01/2016 – 30/04/2016 / 0
Monitoring equipment	No bypass is expected during regular operation
Measuring/reading/recording frequency:	-
Calculation method (if applicable):	n/a
QA/QC procedures:	-
Purpose of data:	Calculation of project emissions
Additional comments:	No bypass is expected during regular operation.

Data/parameter:	**AAM0022 ID 17** **Loss of biogas from pipeline**
Unit	%
Description	Loss of biogas from pipeline
Measured/calculated/default	The biogas pipeline is checked by using mobile gas detector
Source of data	Report by the project developer
Value(s) of monitored parameter	**Monitoring period** / **Average value (%)** 15/09/2014 – 31/12/2014 / 0 01/01/2015 – 31/12/2015 / 0 01/01/2016 – 30/04/2016 / 0

Monitoring equipment	<table><tr><td>SCADA representation / Tag no.</td><td>- / PD-GD-001</td></tr><tr><td>Equipment Type</td><td>Portable gas detector</td></tr><tr><td>Manufacturer</td><td>Industrial Scientific</td></tr><tr><td>Model</td><td>MX4</td></tr><tr><td>Maximum permissible error</td><td>±5%</td></tr><tr><td>Serial No.</td><td>10110R4-006</td></tr><tr><td>Calibration Frequency</td><td>Annually</td></tr><tr><td>Date of previous calibration</td><td>21/11/2013 09/10/2014</td></tr><tr><td>Date of latest calibration</td><td>03/06/2015</td></tr></table>
Measuring/reading/recording frequency:	Periodic test for gas leakage is carried out by the operator which the test readings are recorded in the test report accordingly.
Calculation method (if applicable):	n/a
QA/QC procedures:	Checks to be carried out according to international standards.
Purpose of data:	Calculation of project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 18** **Organic material removed from wastewater facility**
Unit	t COD
Description	Organic material removed from wastewater facility
Measured/calculated/default	Measured by using weighing machine
Source of data	Log sheet
Value(s) of monitored parameter	There is no organic material removal during the monitoring period
Monitoring equipment	<table><tr><td>SCADA representation / Tag no.</td><td>n/a</td></tr><tr><td>Equipment Type</td><td>Weighing machine</td></tr><tr><td>Manufacturer</td><td>Commander</td></tr><tr><td>Model</td><td>HP01</td></tr><tr><td>Maximum permissible error</td><td>±20 kg</td></tr><tr><td>Serial No.</td><td>0000237</td></tr><tr><td>Calibration Frequency</td><td>Once in two years</td></tr><tr><td>Date of previous calibration</td><td>18/01/2013 08/05/2014</td></tr><tr><td>Date of latest calibration</td><td>16/02/2016</td></tr></table>
Measuring/reading/recording frequency:	The measurement shall be done when the organic material is removed from the reactors by using the weighing machine at the starch plant.
Calculation method (if applicable):	n/a
QA/QC procedures:	The weighing machine at the starch plant was undergone maintenance / calibration subject to appropriate industry standards.
Purpose of data:	Calculation of project emissions
Additional comments:	

Data/parameter:	**AM0022 ID 19** **Biogas calorific value**
Unit	J/Nm^3
Description	Calorific value of biogas

Measured/calculated/default	Calculation based on the methane concentration of biogas (ID 11) and NCV of methane
Source of data	ID 11 and NCV of methane
Value(s) of monitored parameter	<table><tr><th>Monitoring period</th><th>Average value (MJ/Nm^3)</th></tr><tr><td>15/09/2014 – 31/12/2014</td><td>24.79</td></tr><tr><td>01/01/2015 – 31/12/2015</td><td>25.10</td></tr><tr><td>01/01/2016 – 30/04/2016</td><td>25.91</td></tr></table>
Monitoring equipment	The methane concentration of biogas is same as ID 11
Measuring/reading/recording frequency:	The calculation for the data is done on a daily basis. The approach is transparently applied in the excel sheet.
Calculation method (if applicable):	The methane concentration of biogas is multiplied by the NCV of methane
QA/QC procedures:	n/a
Purpose of data:	Calculation of baseline emissions
Additional comments:	The methane concentration of biogas is same as ID 11

Data/parameter:	**Flame detection period**
Unit	Min
Description	Amount of minutes per hour where a flame is detected, whenever biogas is sent to the flare. If flame is detected for less than 20 minutes in an hour (whenever biogas is sent to flare), flare efficiency is assumed to be 0%. Otherwise flare efficiency is assumed to be 50%.
Measured/calculated/default	Measured based on flame detection signals by flare
Source of data	Electronic files from Data logger
Value(s) of monitored parameter	The data was not available during the monitoring period.
Monitoring equipment	The flare system is an automated system and makes sure that the biogas is not sent to the flare, if the flame is not detected. The details of the biogas going to the flare system and flame detection are available as part of the automated monitoring system at project site.
Measuring/reading/recording frequency:	The flame detection period shall be compared to the period of biogas being sent to the flare. The flare efficiency is determined based on the ratio of these two values in analogy to the default value determination method.
Calculation method (if applicable):	n/a
QA/QC procedures:	n/a
Purpose of data:	Calculation of project emissions
Additional comments:	Since the data was not available during the monitoring period, the flaring efficiency is assumed as zero percent in order to calculate the project emission for the sake of conservativeness.

Data/parameter:	**Period of biogas being sent to the flare**
Unit	Min
Description	Amount of minutes per hour where biogas is sent to the flare
Measured/calculated/default	Measured/calculated based on SCADA records of biogas flow meter at the entrance of the flare
Source of data	Electronic files from Data logger
Value(s) of monitored parameter	The data was not available during the monitoring period.

Monitoring equipment	The flare system is an automated system and makes sure that the biogas is not sent to the flare, if the flame is not detected. The details of the biogas going to the flare system and flame detection are available as part of the automated monitoring system at project site.
Measuring/reading/recording frequency:	Whenever biogas flow is registered by the SCADA system of the biogas plant, the time is also recorded, which allows for a calculation of the time period of biogas being sent to the flare.
Calculation method (if applicable):	n/a
QA/QC procedures:	n/a
Purpose of data:	Calculation of project emissions
Additional comments:	Since the data was not available during the monitoring period, the flaring efficiency is assumed as zero percent in order to calculate the project emission for the sake of conservativeness.

D.3. Implementation of sampling plan

The section is not applicable since there is no sampling plan used for the monitoring of the project activity.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

The baseline scenario is based on what would have happened in the absence of the project activity. In this case, the baseline scenario is continued operation of the open anaerobic lagoon system, consumption of HFO for thermal energy generation and of electricity from the grid:

Formula (8) AM0022 v4, baseline scenario:

$$E_{BL} = E_{CH4\ lagoons\ BL} + E_{CO2\ heat\ BL} + E_{CO2\ power\ BL} \quad (8)$$

Where:

E_{BL}	are the Total Baseline Emission (tCO_2e)
$E_{CH4\_lagoons\_BL}$	are the fugitive methane emissions from lagoons in the baseline case (tCO_2e). They are calculated with baseline data based on equation 2 in the section on project emissions.
$E_{CO2\_heat\_BL}$	are the CO_2 emissions from on site fossil heat and/or power generation in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility.
$E_{CO2\_power\_BL}$	are the CO_2 emissions related electricity supplied by the grid in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility

1) <u>Fugitive methane emissions from lagoons ($E_{CH4\_lagoon\_BL}$)</u>

Methane emissions from lagoons are calculated using equations (2), (3), (5) and (6). In the baseline case, without the new anaerobic treatment facility, no wastewater material degrades before entering the lagoon

system and all the organic material to be treated enters the lagoons system. Therefore, equation (4) has to be changed for the baseline calculations as shown below:

Formula (11) AM0022 v4, baseline scenario:

$$M_{lagooon\ input\ BL} = M_{input\ total} \quad (11)$$

Where:

$M_{lagooon\_input\_BL}$	is the input of organic material from the new project anaerobic wastewater treatment facility into the lagoon system
$E_{CO2\_power\_BL}$	are the CO_2 emissions related electricity supplied by the grid in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility
M_{input_total}	is the total amount of organic material fed into the baseline wastewater treatment facility

All emission factors for surface aerobic losses of organic material, aerobic degradation, deposition or removal as well as chemical oxidation are determined in the same way as described for project emissions calculations.

2) <u>On site heat generation emissions displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_heat\_BL}$)</u>

In calculating CO_2 emissions from on site heat displaced by biogas collected in the anaerobic treatment, the use of fossil fuels (HFO) is considered:

Formula (9) AM0022 v4, baseline scenario:

$$E_{CO2\_heat} = F * NCV * EF \quad (9)$$

Where:

F	is the corresponding amount of fossil fuel used for on-site heat generation (tons of HFO)
NCV	is the net calorific value of the fossil fuel considered (HFO) in (TJ/t). The default IPCC value of 0.0404 TJ/t from the 2006 IPCC guidelines for National GHG Inventories is applied.
EF	is the carbon emission factor of the fossil fuel considered (HFO) in (tCO_2/TJ). According to the 2006 IPCC guidelines for National GHG Inventories, this value is 77.40 tCO_2/TJ.

3) <u>Off-site grid power generation emissions displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_power\_BL}$)</u>

Formula (10) AM0022 v4, baseline scenario:

$$E_{CO2\_power} = EL * CEF \quad (10)$$

Where:

EL	is the amount of electricity displaced by the electricity generation from the biogas collected from the anaerobic treatment facility. This is estimated as product of: (1) average specific electricity consumption for the output of the facility, estimated using 3 years historical data: and (2) the annual production.
CEF	is the carbon emission factor for the electricity displaced by the electricity generated from the biogas. (tCO_2e/MWh)

E.2. Calculation of project emissions or actual net GHG removals by sinks

Total estimated project emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system, from possible methane emissions from the new anaerobic waste water treatment facility, from incomplete biogas combustion and biogas leaks.

Formula (1) AM0022 v4, project scenario:

$$E_{project} = E_{CH4\_lagoons} + E_{CH4\_NAWTF} + E_{CH4\_IC + Leaks} \quad (1)$$

Where:

$E_{project}$	are the Total Project Emissions (tCO_2e)
$E_{CH4\_lagoons}$	are the fugitive methane emissions from the new anaerobic wastewater treatment facility (tCO_2e)
$E_{CH4\ IC+Leaks}$	are the methane emissions from inefficient combustion and leaks (tCO_2e)

The calculations for each component of equation (1) are provided below.

1) Fugitive Methane Emissions from Lagoons in the project scenario ($E_{CH4\ lagoons}$)

The treated digester effluent is discharged into the old lagoon based system for final treatment. While the residual organic load of the digester is low and removal of the residual COD in the lagoons is expected to occur under aerobic conditions. Fugitive Methane Emissions from the lagoons are calculated assuming mostly anaerobic conditions, which is conservative.

Formula (2) AM0022 v4, project scenario:

$$E_{CH4\ lagoons} = M_{lagoon\ anaerobic} * EF_{CH4} * GWP_{CH4} / 1000 \quad (2)$$

Where:

$M_{lagoon\_anaerobic}$	is the amount of organic material removed by anaerobic processes in the lagoon system (kgCOD).
EF_{CH4}	is the methane emission factor (kgCH4/kgCOD). 0.21 kgCH4/kgCOD of COD to Methane conversion factor is used.
GWP_{CH4}	is the Global Warming Potential of methane ($GWP_{CH4} = 25$[7])

[7] The value of 25 is effective from 01/01/2013

Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic}$)

Formula (3) AM0022 v4, project scenario:

$$M_{lagoon\_anaerobic} = M_{lagoon\_total} - M_{lagoon\_aerobic} - M_{lagoon\_chemical\_ox} - M_{lagoon\_deposit} \quad (3)$$

Where:

M_{lagoon_total}	is the total amount of organic material removed in the lagoon system from equation (5) (kgCOD)
$M_{lagoon\_aerobic}$	is the amount of organic material degraded aerobically in the lagoon system (kg COD). Surface aerobic losses of organic material in pond based systems equal to 254 kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processed.
$M_{lagoon\_chemical\_ox}$	is the amount of organic material lost through chemical oxidation in the lagoon system (kg COD)
$M_{lagoon\_deposit}$	is the amount of organic material lost through deposition in the lagoon system from equation (6) (kg COD)

Amount of organic material removed in the lagoon system (M_{lagoon_total})

Formula (5) AM0022 v4, project scenario:

$$M_{lagoon\_total} = M_{lagoon\_input} * R_{lagoon} \quad (5)$$

with Formula (4) AM0022 v4, project scenario:

$$M_{lagoon\_input} = M_{input\_total} * (1 - R_{NAWTF}) \quad (4)$$

Where:

M_{lagoon_input}	is the input of organic material from the new project anaerobic wastewater treatment facility into the lagoon system (kg COD)
R_{lagoon}	is the total organic material removal ratio of the lagoon. It is a project specific factor, and is equal to the proportion of organic material removed (though all route) within the boundarie of the lagoon system under consideration.
M_{input_total}	is the total amount of organic material fed into the new project wastewater treatment facility (kg COD)
R_{NAWTF}	is the total organic material removal efficiency of the new project wastewater treatment facility. The manufacture's guaranteed COD removal ratio of 90% (according to the technical proposal) is used as a project specific value.

The Total Organic Removal Ratio (R_{lagoon}) factor has been determined according to Appendix 2 of AM0022, Version 04 by undertaking a series of chemical analyses based on COD samples at the inlet and the outlet of the lagoon system boundary. Based on the results of the chemical analysis, the Total Organic Removal Ratio is calculated as average value of the test series as follows:

$R_{lagoon} = ((COD_{in} - COD_{out}) / COD_{in})_{average}$

Where:

COD_{in}	is the COD concentration of the wastewater at the inlet of the lagoon system
COD_{out}	is the COD concentration of the wastewater at the outlet of the lagoon system

The series of collected COD samples at the inlet and outlet of the lagoon system indicate an average Total Organic Removal Ratio (R_{lagoon}) of 98.9% (see Annex 1 for more details).

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic}$)

The amount of organic material degraded aerobically in the lagoon system is calculated as the product of the AM0022, Version 04 default value for surface aerobic losses of organic material in pond based systems (254 kg COD/ha/day), total surface area of the lagoons (25.18 ha) and number of days in a year (365 days). Although no explicit equation is provided in AM0022, Version 04, following formula is applied:

$M_{lagoon\ aerobic} = COD_{loss\ aerobic} \times A_{lagoon\ surface} \times dd_{year}$

Where:

$COD_{loss\ aerobic}$	is the default value for surface aerobic losses of organic material (254 kg COD/ha/day)
$A_{lagoon\ surface}$	is the total surface area of the lagoon based wastewater treatment system (in ha)
dd_{year}	is the number of days per year (in days)

$M_{lagoon\_aerobic}$ = 254 (kg COD/ha/day) x 25.18 (ha) x 365 day/yr = 2,334,438 kg COD/year

As per the methodology, sensitivity analysis is conducted in order to determine the effect of change in the surface aerobic loss of COD to the emission reductions. The results of the sensitivity analysis indicate that the default value of 254 kg COD/ha/day) is appropriate for emission reduction calculations (see Annex 1 for details).

Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox}$)

The amount of organic material lost through chemical oxidation in the lagoon system is calculated based on guidance provided in Appendix 2 of AM0022, Version 04. Although no explicit equation is provided, following formula is applied:

$M_{lagoon\ chemical\ ox} = WW_{in} \times SO_4^{2-}{}_{concentration} \times COD_{loss\ chem\ ox}$

Where:

WW_{in}	wastewater flow entering system boundaries in m^3/yr
$SO_4^{2-}{}_{\_concentration}$	sulphate (Q_{ox}) concentration in kg Q_{ox} /m^3
$COD_{loss\ chem\ ox}$	COD removal factor in kg COD/kg Q_{ox} (0.651 kg COD/kg SO_4^{2-})

Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition}$)

Formula (6) AM0022 v4, project scenario:

$$M_{lagoon\_deposition} = M_{lagoon\_input} * R_{deposition} \quad (6)$$

Where:

$R_{deposition}$	is the organic material deposition ratio of the lagoon. It is equal to the proportion of organic material physically sedimented in lagoons within the project boundaries. It is a project specific factor derived by assessing the relative ability of COD in the wastewater stream to sediment the project boundaries, through pre project analysis.

A series of experiments described in detail under Annex 1 show that the average Organic Material Deposition Ratio ($R_{deposition}$) is determined based on a conservative approach as 7.05%.

2) Methane emissions from new anaerobic waste water treatment facility (E_{CH4_NAWTF})

Methane emissions from the specific anaerobic wastewater treatment facilities that are installed by the Project, are assessed and estimated based on monitoring measurements, technology supplier data and expert estimates. They may be disregarded if documented evidence for their insignificance is given.

The technology provider, GLOBAL WATER ENGINEERING (GWE) LTD., has estimated based on their experience that the physical leakage from the UASB system is less than 1% for systems with similar size and design to the project activity. To ensure conservativeness, physical leakage factor of 1% of total biogas production is used for the Project activity.

Although no explicit formula is provided under AM0022, Version 04 for calculation of methane emissions from the new anaerobic wastewater treatment facility (E_{CH4_NAWTF}), following formula is applied:

$$E_{CH4\ NAWTF} = (E_{CH4\ lagoon\ BL} - E_{CH4\ lagoon}) \times F_{leakage\ NAWTF}$$

Where:

$E_{CH4\_lagoon\_BL}$	are the fugitive methane emissions from lagoons in the baseline scenario (t CO_2e)
E_{CH4_lagoon}	are the fugitive methane emissions from lagoons in the project scenario (t CO_2e)
$F_{leakage\ NAWTF}$	is the leakage factor for the new wastewater treatment system (1%)

3) Methane emissions from inefficient combustion emissions ($E_{CH4\_IC+Leaks}$)

The project involves on site heat and electricity generation and biogas flaring (in case of excess biogas production or technical problems related to the heat and electricity generation equipment).

Formula (7) AM0022 v4, project scenario:

$$E_{CH4\ IC+Leaks} = (\sum_r V_r * C_{CH4\ r} * (1- f_r) * GWP_{CH4}) + PE_{flare} \quad (7)$$

Where:

the sum	is made over two routes r for methane destruction (heating and power generation)

V_r	is the biogas combustion process volume in route r (Nm^3)
$C_{CH4\ r}$	is the methane concentration in biogas (tCH_4/Nm^3)
f_r	is the proportion of biogas destroyed by combustion (-)
PE_{flare}	are the project emissions from flaring of the residual gas stream (tCO_2e) calculated following the procedures described in the "Tool to determine project emissions from flaring gases containing Methane". PE_{flare} can be calculated on an annual basis or for the required period of time using this tool.

The values applied as "proportion of biogas destroyed by combustion" are 98.5% for the heat generation equipment (f_{boiler}) and 99% for the electricity generation equipment (f_{engine}).

Among the options for flaring systems, an open flare system is chosen by the project participants. For the determination of the flare efficiency, the default values for open flares proposed in the "Tool to determine project emissions from flaring of gases containing methane" are used for the calculation of project emissions from flaring gases. Following equations from the flaring tool are used to determine the project emissions from flaring of the residual gas stream.

$$PE_{flare,y} = (\sum TM_{RG,h} * (1- \eta_{flare,h}) * GWP_{CH4}/1000$$

As per the registered PDD, the flaring efficiency of the project activity shall be estimated by using the data of flame detection period and period of biogas sent to flare. However, the data was not available during the monitoring period, the flaring efficiency is assumed as zero percent in order to calculate the project emission.

f_{heat}: the test was done as per following details for the exhaust gas analysis provides the percentage of un-burnt hydrocarbon in the exhaust gas.

Date of test report	Test result (ppm)	Combustion efficiency (%)[8]
18/02/2014	3.02	99.9997%
14/08/2015	45.71	99.9954%
16/03/2016	70.32	99.9930%

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.

f_{elec}: the test for two generators was done as per following details for the exhaust gas analysis provides the percentage of un burnt hydrocarbon in the exhaust gas.

Date of test report	Test result (ppm)	Combustion efficiency (%)
Generator A		
18/02/2014	143	99.9857%
17/08/2015	52.09	99.9948%
17/03/2016	24.09	99.9976%
Generator B		
20/02/2014	254	99.9746%
17/08/2015	56.78	99.9943%
17/03/2016	70.58	99.9929%

[8] **Calculation method**
The result from the report is 3.02 ppm at actual oxygen levels
3.02 ppm = 3.02 in 1,000,000 units = 0.00000302 = 0.000302% of non-combustion
Therefore, the combustion efficiency is 99.9997%.

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.

4) Methane Emissions from Leaks in Biogas System

Leaks in the biogas system include leaks from the anaerobic digester and leaks from the biogas pipeline delivery system. The UASB reactor gas collection system consists of a gas-tight concrete, coated gas dome and the biogas pipeline is made of stainless steel (AISI 304) and approximately 385 m long. Given the short length of the biogas pipeline (as compared to the reference value of 2 km provided in AM0022, Version 04) and the utilisation of high quality materials, emissions from leaks in the biogas system are assumed to be negligible.

E.3. Calculation of leakage

As determined in AM0022, Version 04, leakage is considered to be negligible.

E.4. Summary of calculation of emission reductions or net GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	135,033	2,818	0	N/A	122,610	122,610

Note: Conservative estimate of 9,605 tCO2e is deducted from baseline emissions to get the final emission reduction of 122,610 tCO2e.

E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	161,265	122,610

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

The actual emission reduction achieved during this monitoring period is less than the values estimated in ex-ante calculation of the registered PDD.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	CYY Bio Power Co Ltd
Street/P.O. Box	100 Moo 5 Tambol Pongdaeng
Building	
City	Amphur Khamtalesor
State/region	Nakhorn Ratchasima
Postcode	30280
Country	Thailand
Telephone	+ 66 44 397 337, 8
Fax	
E-mail	Parintorn2506@hotmail.com
Website	
Contact person	Ms. Parinthom Yuenyong
Title	
Salutation	
Last name	Yuenyong
Middle name	
First name	Parinthorn
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Kommunalkredit Public Consulting GMBH
Street/P.O. Box	Tuerkenstrasse 9
Building	
City	Vienna
State/region	
Postcode	1092
Country	Austria
Telephone	
Fax	
E-mail	
Website	www.ji-cdm-austria.at
Contact person	Wolfgang Diernhofer
Title	
Salutation	
Last name	Diernhofer
Middle name	
First name	Wolfgang
Department	
Mobile	
Direct fax	+43131631104
Direct tel.	+43131631380
Personal e-mail	w.diernhoferKyoto@kommunalkredit.at

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	South Pole Carbon Asset Management Ltd.
Street/P.O. Box	Technoparkstrasse 1
Building	
City	Zurich
State/region	
Postcode	8005
Country	Switzerland
Telephone	+41446337870
Fax	+41446331423
E-mail	registration@thesouthpolecarbongroup..com
Website	
Contact person	Renat Heuberger
Title	
Salutation	
Last name	Heuberger
Middle name	
First name	Renat
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Gold Standard monitored parameters

<table>
<tr><td colspan="2">No</td><td>1</td></tr>
<tr><td colspan="2">Indicator</td><td>Water quality and quantity</td></tr>
<tr><td colspan="2">Chosen parameter</td><td>COD concentration in wastewater at the outlet of the UASB reactor (in kg COD / m^3)</td></tr>
<tr><td colspan="2">Implications on monitoring requirements and justification</td><td>The aim of the project is to improve the current wastewater treatment facilities and avoid any harm or threat to the environment or people. The installed wastewater treatment system is more efficient and robust (from a process control perspective) than the open anaerobic lagoon system (baseline scenario). The biogas reactor system reduces 90% to 98% of the COD load in the wastewater. The effluent from the biogas reactor is still diverted to the old lagoon system, for a final treatment, which further reduces the COD load to a value well below the Thai wastewater discharge limits.
The lagoon system at CYY is designed in such a way that there is no effluent leaving the lagoon system. Most of the produced wastewater is constantly re-circulated as wash water for the starch production process. The rest is stored in the aerobic lagoons at the end of the cascading lagoon system, where part of the water evaporates, keeping a hydrological balance.
The wastewater treatment plant includes safety and monitoring devices as well as safety and quality control procedures in order to avoid abnormal operating conditions, which could lead to abnormal wastewater discharges. Wastewater quality format the outlet of the reactor is already subject to continuous monitoring under CDM and periodic controls by environmental authorities.
Given the fact that the treated wastewater cannot be discharged and is constantly re-circulated and re-used in the starch plant, which was already done prior to the project, the project activity does not have a significant impact on water quantity,
From this, it is evident that the impact on the water quality is the only crucial for an overall positive impact of sustainable development and its monitoring would thus be required in the verification period.</td></tr>
<tr><td rowspan="3">Way of monitoring</td><td>How</td><td>Daily sampling of the UASB reactor effluent. COD concentration is analyzed daily at the Project site. The Reactor Digestion Method is applied for wastewater analysis.</td></tr>
<tr><td>When</td><td>Daily</td></tr>
<tr><td>By who</td><td>CYY plant operator</td></tr>
<tr><td colspan="2">QA/QC procedures to be applied</td><td>The Standard Solution Method is used for accuracy check of the on-site measurements. Periodic tests will be carried out by accredited laboratory (ISO/IEC 17025) in order to provide quality assurance.</td></tr>
<tr><td colspan="2">Monitored Value & Frequency</td><td>
<table>
<tr><th>Monitoring period</th><th>Average value (kg COD/m^3)</th></tr>
<tr><td>15/09/2014 - 31/12/2014</td><td>2.11</td></tr>
<tr><td>01/01/2015 - 31/12/2015</td><td>2.26</td></tr>
<tr><td>01/01/2016 - 30/04/2016</td><td>2.63</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td colspan="2">No</td><td>2</td></tr>
<tr><td colspan="2">Indicator</td><td>Air quality:
Odour from the wastewater treatment plant</td></tr>
<tr><td colspan="2">Chosen parameter</td><td>Volume of biogas production and combustion (Nm^3)</td></tr>
<tr><td colspan="2">Implications on monitoring requirements and justification</td><td>As explained by the project owner during the public consultation, the odour is reduced as a result of the project activity, because the new system is a closed system and the biogas produced is utilized for electricity and heat generation. Any gases that would lead to odour 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 would be sufficient to demonstrate a reduction in odour emissions from the project.</td></tr>
<tr><td rowspan="3">Way of monitoring</td><td>How</td><td>Measured using gas flow meters at the reactor outlet and at the inlet of the boiler, engine/generator sets and flare system. Combustion of the biogas, and consequently the destruction of any gases that would lead to odour emissions, is monitored through measurement of the energy output of the boiler and engine/generator systems as well as the flame detection period of the flare system. More details about all these parameters are provided in the monitoring plan (Section B.7) of the registered PDD.</td></tr>
<tr><td>When</td><td>Continuously using totaliser meters</td></tr>
<tr><td>By who</td><td>CYY plant operator</td></tr>
<tr><td colspan="2">QA/QC procedures to be applied</td><td>Meters will undergo maintenance / calibration subject to appropriate industry standards. In the event of technical problems with a biogas flowmeter, the value can be calculated based on a mass balance using the other installed gas meters (e.g. biogas sent to boilers = total biogas produced – biogas sent to flare – biogas sent to engine).</td></tr>
<tr><td colspan="2">Monitored Value & Frequency</td><td>Following values are referred from the parameters, AM0022 ID 5 (volume of biogas sent to boiler), AM0022 ID 9 (volume of biogas sent to flare) and AM0022 ID 10 (volume of biogas sent to gas engines). The details of the parameters can be found in section D.2 of the monitoring report.

<table>
<tr><th>Monitoring period</th><th>biogas to boiler (Nm^3)</th><th>biogas to flare (Nm^3)</th><th>biogas to gas engines (Nm^3)</th></tr>
<tr><td>15/09/2014 - 31/12/2014</td><td>1,236,730</td><td>94</td><td>549,937</td></tr>
<tr><td>01/01/2015 - 31/12/2015</td><td>4,330,527</td><td>727</td><td>1,140,824</td></tr>
<tr><td>01/01/2016 - 30/04/2016</td><td>1,663,279</td><td>0</td><td>228,486</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td colspan="2">No</td><td>3</td></tr>
<tr><td colspan="2">Indicator</td><td>Employment (numbers)</td></tr>
<tr><td colspan="2">Chosen parameter</td><td>Number of employed staffs and the level of income generation</td></tr>
<tr><td colspan="2">Implications on monitoring requirements and justification</td><td>To date the job creation has been in the higher end of the range and the owner expects it to increase. Reference to the organisation chart is also made available.</td></tr>
<tr><td>Way of monitoring</td><td>How</td><td>Number of employees and the level of income generation are recorded through salary payment records.</td></tr>
</table>

<table>
<tr><td></td><td>When</td><td>Monthly</td></tr>
<tr><td></td><td>By who</td><td>CYY</td></tr>
<tr><td colspan="2">QA/QC procedures to be applied</td><td>NA. Careful monitoring of salary payments and expenditures is a general practice of the company required for financial accounting as per Thai regulations.</td></tr>
<tr><td colspan="2">Monitored Value & Frequency</td><td>Monthly records for list of employees and income generation are provided as attachments.

Number of employees is provided as follows.

<table>
<tr><th>Monitoring period</th><th>Number of employees</th></tr>
<tr><td>15/09/2014 - 31/12/2014</td><td>19</td></tr>
<tr><td>01/01/2015 - 31/12/2015</td><td>13</td></tr>
<tr><td>01/01/2016 - 30/04/2016</td><td>24</td></tr>
</table>

The level of income generation is provided as follows. According to the detail provided, the project paid employees the minimum local level for Na province. In addition, some employees can be paid the wages higher than the minimum one because of a few reasons, such as experience, position, diligence allowance.

<table>
<tr><th>Monitoring period</th><th>Income level (THB/day)[1]</th><th>Minimum local level[2] (THB/day)</th></tr>
<tr><td>15/09/2014 - 31/12/2014</td><td>300 – 755</td><td rowspan="3">300</td></tr>
<tr><td>01/01/2015 - 31/12/2015</td><td>300 – 808</td></tr>
<tr><td>01/01/2016 - 30/04/2016</td><td>300 – 808</td></tr>
</table>
[1] Minimum income level is referred to the daily wage of the employees of the project. Maximum is calculated by using highest salary divided by number of days (30).
[2] Minimum local level in Nakorn Ratchasima province of 2014 to 2016 is referred to the Notification of the wage on the minimum wage No.7 which the document is provided to the verification team.</td></tr>
</table>

No		4
Indicator		Technological self-reliance
Chosen parameter		Training records
Implications on monitoring requirements and justification		The project contributes to technology transfer and has a great replication potential in the starch sector in Thailand and other countries. In Thailand, GWE, the technology provider for this particular project, implements the technology along with a special training for operators at the project site.
Way of monitoring	How	Training records are archived at the end of each training
	When	Periodical (depending of the frequency of training)
	By who	CYY
QA/QC procedures to be applied		All training plans are approved by the plant manager prior to implementation.
Monitoring Value and Frequency		Following training programs have been provided to operators. Further, summary of the training with attendees and trainer has been submitted to the verification team. - Operation and maintenance of biogas system - Safety in biogas operation - Knowledge of biogas - Wastewater analysis

No		-
Indicator		Sludge application
Chosen parameter		Type of sludge application
Implications on monitoring requirements and justification		This parameter is included as an addition to the monitoring plan to satisfy comment/request 2 of the GS registration review process.
Way of monitoring	How	The log book of the operator tracks the sludge application at the plant. In the case that the sludge is sold to farmers, a confirmation on the sludge application must be given by the purchasers. Note that the sludge will only be used for soil application as fertiliser.
	When	Plant record every time sludge is removed from the system
	By who	CYY
QA/QC procedures to be applied		Plant manager's signature is required on the record
Monitored Value & Frequency		There was no sludge removed during the monitoring period.

Additional information about the monitoring period:

- In the current monitoring period, the methane utilization ratio for biogas is approximately 99.91%, which is over 65% limit as per GS regulations.