

# MONITORING REPORT OF WASTEWATER TREATMENT WITH BIOGAS PRODUCTION (UASB) AND HEAT UTILIZATION AT GENERAL STARCH CO., LTD.



Document Prepared By South Pole Carbon Asset Management Ltd.

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|                          |                                                                                                                                                                                                                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Title</b>     | Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd                                                                                                                                                                                |
| <b>Version</b>           | 02                                                                                                                                                                                                                                                                                |
| <b>Report ID</b>         | 300044/06                                                                                                                                                                                                                                                                         |
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| <b>Project ID</b>        | 82                                                                                                                                                                                                                                                                                |
| <b>Monitoring Period</b> | 01-January-2012 to 31-December-2013                                                                                                                                                                                                                                               |
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## 1 PROJECT DETAILS

### 1.1 Summary Description of the Implementation Status of the Project

The project activity involves the installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) technology, at a starch manufacturing plant that has been in operation since 1995. Prior to project implementation, the wastewater was treated using an open lagoon system.

The first phase of the project (UASB 1) was implemented at General Starch Co., Ltd. in 2003 with start up of operations in January 2004, and the second phase of the project (UASB 2) began in 2005 with start up of operations in January of 2006. The biogas produced from anaerobic digestion is captured and then used as fuel for heat generation.

As per the VCS's guideline, the project is verified against the VCS standard. Further background information on the project activity can be found in the VCS Project Design Document (PDD), which has been registered and available on the V-C-S under project number 82 as well as the combined Voluntary Validation and Verification:

<https://vcsprojectdatabase1.apx.com/mymodule/ProjectDoc/EditProjectDoc.asp?id1=82>

This is the 6<sup>th</sup> verification of the project. Details of previous monitoring periods are listed below. All monitoring and verification reports are available on the VCS registry.

- 1<sup>st</sup> monitoring period : 01-04-04 to 31-05-07 ; verification report issued 31-08-07
- 2<sup>nd</sup> monitoring period: 01-06-07 to 31-03-08 ; verification report issued 22-08-08
- 3<sup>rd</sup> monitoring period: 01-04-08 to 31-08-09 ; verification report issued 09-02-10
- 4<sup>th</sup> monitoring period: 01-09-09 to 31-08-10 ; verification report issued 06-05-11
- 5<sup>th</sup> monitoring period: 01-09-10 to 31-12-11 ; verification report issued 21-05-12

### 1.2 Sectoral Scope and Project Type

The project sectoral scope, as defined by the UNFCCC, is: 13 – Waste handling and disposal.

### 1.3 Project Proponent

|                   |                                                                   |
|-------------------|-------------------------------------------------------------------|
| Organization name | Papop Renewable Co.,Ltd                                           |
| Contact person    | Likit Nimtrakul                                                   |
| Title             | Mr.                                                               |
| Address           | 43 Soi Prasertmanookij 5 , Jorakaebua , Ladphrao<br>Bangkok 10230 |
| Telephone         | +66 2 570 5580                                                    |
| Email             | likit@papop.com                                                   |

#### 1.4 Other Entities Involved in the Project

|                     |                                                 |
|---------------------|-------------------------------------------------|
| Organization name   | South Pole Carbon Asset Management Ltd.         |
| Role in the project | Carbon consultant                               |
| Contact person      | Ingo Puhl                                       |
| Title               | Mr.                                             |
| Address             | Technoparkstrasse 1 , Zurich , Switzerland 8005 |
| Telephone           | +66 2 678 8979                                  |
| Email               | i.puhl@southpolecarbon.com                      |

#### 1.5 Project Start Date

The commissioning date of the first UASB reactor was 1<sup>st</sup> Jan 2004.

#### 1.6 Project Crediting Period

The crediting period is from 1<sup>st</sup> January 2004 to 31<sup>st</sup> December 2013. The initial crediting period was 7 years and then extended to 10 years. The subsequent renewals of the crediting time might be considered according to the status of the project activity and baseline revision at that time.

#### 1.7 Project Location

The proposed project site is located on Ratchasima-Chokchai Road, Amphur Kornburi in Nakorn Ratchasima Province, which is in the northeast of Thailand. Nakorn Ratchasima, about 250 km away from Bangkok, is one of the five biggest cities in Thailand. Most of the tapioca starch plants in Thailand are located in this province. The closest Railway station is Jira Station, and the closest airport is Nakorn Ratchasima.

Address : No. 99, Chok Chai – Kornburi Road, Amphur Kornburi, Nakhorn Ratchasima

GPS coordinates : 14.580219,102.186799



**Figure 1 : Project Location**

## 1.8 Title and Reference of Methodology

Avoided wastewater and on-site energy use emissions in the industrial sector – version 04 (AM0022, version 04). It is hereafter referred to as the “baseline methodology”.

## 1.9 Other Programs

N/A

## 2 IMPLEMENTATION STATUS

### 2.1 Implementation Status of the Project Activity

In this monitoring period, as a result of the improvement of UASB performance, the COD reduction as well as biogas generation is increased in this monitoring period.

- Since the biogas generated was higher than the expected levels and more than the utilization capacity of boilers, new boiler no.10 and 11 are installed in this monitoring period (boiler no.6 and 9 has been installed in the previous monitoring period). The deviation applied due to these additional boilers is described in the following section.
- As a result of the increment of starch production amount, the wastewater plant has to increase its capacity to handle the additional generated wastewater. The new covered lagoons no.3 has been installed. The amount of wastewater treated and biogas produced by this reactor is excluded from emission reduction calculation.
- The biogas discharge line from blowers is modified. From one line, separated into two lines with separate flow meters. The new monitoring diagram is presented in Figure 3.

- The order of meters is changed from the previous monitoring period , as the consequence from the new CL3 , additional measuring equipment and the modification of biogas pipeline.

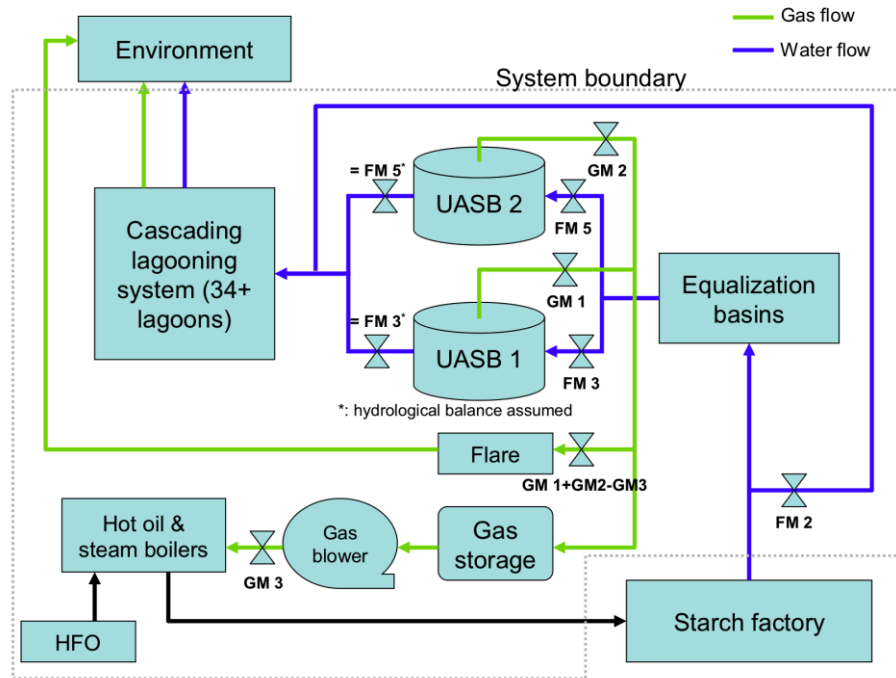


Figure 2 : Monitoring diagram from the registered PD

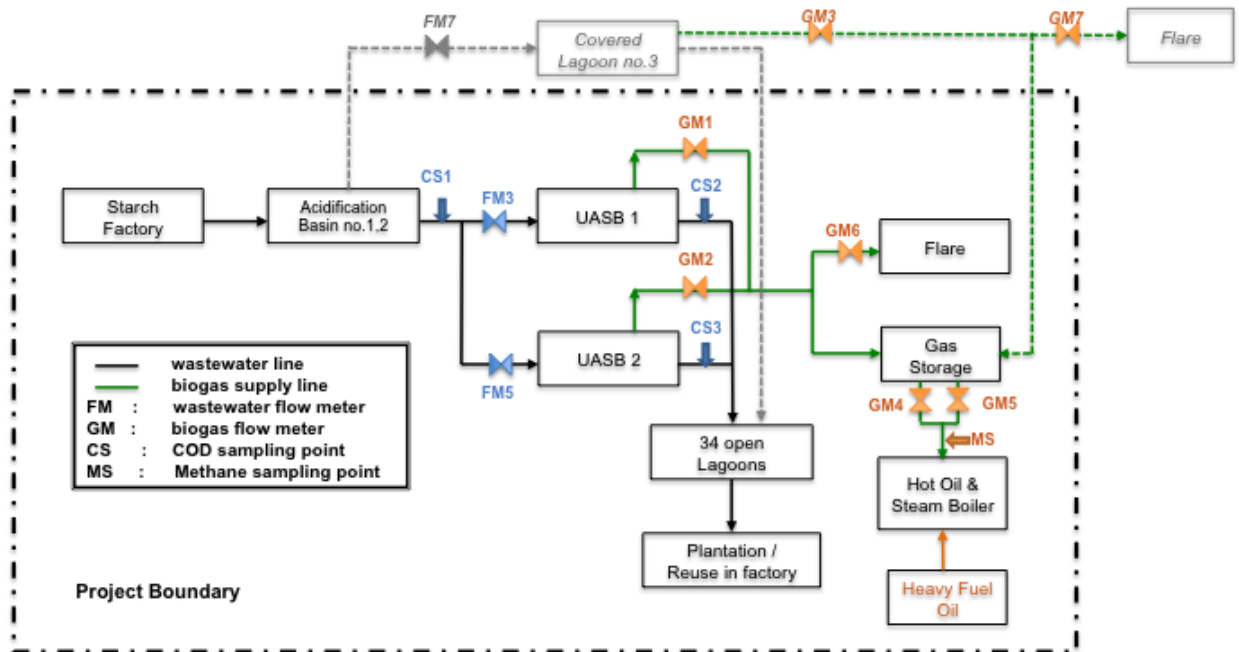


Figure 3 : Monitoring diagram after installation of CL3

- The changings of project activity occurred in this monitoring period is summarized in table below.

**Table 1 : The chronology of events**

| Description of event                                                                                                  | Date occur                |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1. Commissioning date of boiler no.10                                                                                 | 09-Mar-12                 |
| 2. Changing in biogas supply line with new GM installation - Start using GM4 (existing) and GM5 (relocate from flare) | 25-Dec-12                 |
| 3. Shutoff flare system                                                                                               | 25-Dec-12 to<br>29-May-13 |
| 4. Installation of new GM6 (Flare)                                                                                    | 29-May-13                 |
| 4. Commissioning date of new covered lagoon (start feeding wastewater)                                                | 12-Sep-13                 |
| 5. Commissioning date of boiler no.11                                                                                 | 28-Sep-13                 |

## 2.2 Deviations

### 2.2.1 Methodology Deviations

There is no methodology deviations applied during this monitoring period.

### 2.2.2 Project Description Deviations

#### Deviation 1

The new covered lagoon no.3 are installed after the registration of the project. The biogas produced from this reactor is not included for the emission reduction calculation.

#### Justification for deviation

In this approach the biogas produced from the covered lagoon 3 , which is sent to the existing gas storage is excluded from the estimation of the baseline emissions in 2013.

This deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

#### Description of deviation

#### *Status in this monitoring period*

The new covered lagoon has been installed and commissioned on as above. The new biogas flow meters , GM3 and GM7 are installed to measure the amount of biogas produced and flared accordingly.

*Deviated approach*

The portion of biogas burnt at boilers which supplied from the CL3 is excluded from total biogas usage by boilers. Only the biogas production from UASB no.1,2 is considered for emission reduction calculation. The calculation is done by the following steps.

- a) Total biogas sent to boilers is calculated by ;

$$V_{\text{boiler-supplied}} = BG_{GM1} + BG_{GM2} + BG_{GM3} - BG_{GM6} - BG_{GM7}$$

- b) Calculate the portion of biogas produced from CL3 which sent to boilers ;

$$\text{Biogas supplied from CL3} = (BG_{GM3} - BG_{GM7}) / V_{\text{boiler-supplied}} * 100 \%$$

- c) Calculate the new  $V_{\text{boiler}}$  ;

$$V_{\text{boiler}} = (BG_{GM4} + BG_{GM5}) * (100\% - \% \text{ Biogas supplied from CL3.})$$

**Deviation 2**

The new steam boilers no.6 , 9 ,10 and 11 which were installed after the registration of the project are not included in the emission reduction calculation.

Justification for deviation

In this approach the biogas used in the new boilers is excluded from the estimation of the baseline emissions. This deviation has been established since the previous monitoring period.

This deviation does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

Description of deviation

*Status in this monitoring period*

There were two new steam boilers (no.10,11) installed during the monitoring period included with two boilers (no.6,9) previously installed, after the registration of this project activity. The biogas consumed by all four boilers is excluded from the total biogas combusted, monitored as per GM4 and GM5.

*Deviated approach*

The GM4 and GM5 are the biogas flow meters installed at the main biogas supply line to boilers. There is no separate biogas flow meter for each boiler. The biogas usage by each boiler is calculated as described below.

- a) PP conducted a test to identify the maximum biogas consumption for each boiler at full load stage. During the test one boiler is running at 100% of its capacity, and the biogas totalized flow at biogas flow meter is recorded when boiler is started and stopped. The resulting figures are used to calculate biogas consumption during operational hours. The operation hours for each boiler are available on a daily basis from log records. The running hour of each boiler multiplied by its maximum biogas consumption is the biogas amount consumed. Then the percentage of biogas amount consumed by each boiler is calculated.

- b) The above percentage is multiplied with the actual biogas consumption counted by GM4 and GM5 to identify the biogas amount sent to each boiler on monthly basis.

The result of biogas consumed by boilers is presented in Table 2. The biogas consumption of steam boiler no.6 , 9 , 10 and 11 is deducted from  $V_{\text{boiler}}$ , which is total biogas sent to boilers for emission calculation.

### Deviation 3

#### Description of deviation

The monitoring description for ID11 , biogas methane concentration is ; *the gas analyzers are continuously monitored and summarized on daily basis.*

There are some days in this monitoring period, which the data is not available.

#### Period of deviation

This deviated approach is applied for the whole motoring period.

#### Deviated approach

The monitored data is adjusted for 95% confidence level as described in the following steps.

- 1) Calculate sample mean ( $\mu$ ).

$$\mu_{WCH_4,y} = \sum_{m=1}^{n_m} W_{CH_4,m,y} / n_m$$

Where :

$\mu_{WCH_4,y}$  = Mean of the fraction of methane in the biogas in year y (%)

$W_{CH_4,m,y}$  = Monitored fraction of methane in biogas in measurement m in year y (%)

$n_m$  = Number of measurements m in year y (minimum is 4)

- 2) Calculate the sample standard deviation ( $\sigma$ ).

$$\sigma_{WCH_4,y} = \sqrt{\sum_{m=1}^{n_m} (W_{CH_4,m,y} - \mu_{CH_4,y})^2 / (n_m - 1)}$$

Where :

$\sigma_{WCH_4,y}$  = Standard deviation of the fraction of methane in biogas in year y (%)

- 3) Calculate the 95% confidence interval.

$$\mu_{WCH_4,y} - t * \sigma_{WCH_4,y} / \sqrt{n_m} \leq W_{CH_4,y} \leq \mu_{WCH_4,y} + t * \sigma_{WCH_4,y} / \sqrt{n_m}$$

Where :

$t$  = Value from standard  $t$  distribution for a confidence level of 95% with degrees of freedom  $n_m - 1$ <sup>1</sup>

- 4) Use the lower bound of the 95% confidence interval obtained above for BE calculation and the upper bound one for PE calculation to ensure conservativeness.

The above calculating is performed in the ER calculation spreadsheet, deviation 3 in the data sheet.

#### Justification for deviated approach

Since there is no explanation about statistical analysis in the AM0022. The reference for other sources are applied.

This approach is inline to item.36 of AMS III.H version 13 that *“The fraction of methane in the gas should be measured with a continuous gas analyzer, or, alternatively, with periodically measurement at 95% confidence level”*. Additionally the guidelines to calculate the fraction of methane from Annex 13 of EB 48, is referred. To be inline with conservative principle, the upper bound value is used for project emission calculation.

## 2.3 Grouped Project

This project is not a grouped project.

## 3 DATA AND PARAMETERS

### 3.1 Data and Parameters Available at Validation

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | EF <sub>CH4</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Data unit                                                                                    | kg CH <sub>4</sub> / kg COD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Description                                                                                  | Methane emission factor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Source of data                                                                               | Expert selection based on AM0013 v4 guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Value applied:                                                                               | 0.241                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Justification of choice of data or description of measurement methods and procedures applied | <p>The CH<sub>4</sub> emissions factor for the tapioca starch wastewater is determined from the proportion of COD that has been degraded and has formed methane in the new wastewater treatment system. It is calculated using measured data over a 12 months period using the following formula:</p> $EF_{CH_4} = (\text{produced biogas (Nm}^3/\text{a)} * \text{average CH}_4 \text{ concentration} * \text{density of methane at normal conditions (kg/ Nm}^3)) / ((\text{CODin (kg/a)} - \text{CODout (kg/a)}).$ <p>For conservativeness reasons, this figure must be smaller than the maximum theoretical methane producing capacity of 0.25 kg CH<sub>4</sub>/</p> |

<sup>1</sup> <http://www.stat.tamu.edu/~lzhou/stat302/T-Table.pdf>

|                     |                                                                                    |
|---------------------|------------------------------------------------------------------------------------|
|                     | kg COD.                                                                            |
| Purpose of the data | Calculation of project emissions                                                   |
| Comments            | Details of calculation and data used are provided in Annex 3 of registered VCS PD. |

|                                                                                              |                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | R <sub>lagoon</sub>                                                                                                                                                                     |
| Data unit                                                                                    | %                                                                                                                                                                                       |
| Description                                                                                  | Organic material removal ratio                                                                                                                                                          |
| Source of data                                                                               | Applied from registered project no 1040 "Korat Waste to Energy"                                                                                                                         |
| Value applied:                                                                               | 87.88                                                                                                                                                                                   |
| Justification of choice of data or description of measurement methods and procedures applied | Estimated by registered project No 1040 "Korat Waste to Energy" project using historical COD data of wastewater from tapioca starch from lagoon system located 50 km from project site. |
| Purpose of the data                                                                          | Calculation of baseline emissions                                                                                                                                                       |
| Comments                                                                                     | The project developer did not carry out biochemical tests prior to project implementation. For this reason, comparable test results were used.                                          |

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | R <sub>deposition</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Data unit                                                                                    | %                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Description                                                                                  | Organic material deposition ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Source of data                                                                               | Estimated by project developer on basis of experience                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Value applied:                                                                               | 0 (project scenario), 0 (baseline scenario)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Justification of choice of data or description of measurement methods and procedures applied | Estimated by project developer as follows: a) Project scenario Value from registered project no 1040 "Korat waste to energy" is applied here which has been determined using Appendix 3 of AM0022. According to this analysis, all solid material that could sediment is assumed to be removed by the UASB system implemented by the project activity. This is a conservative assumption. b) Baseline scenario Value from registered project no 1040 "Korat waste to energy" is applied: the analysis determined that there is little or no sedimentation occurring in the anaerobic pond as the anaerobic activity effectively keeps all solid COD material in suspension. |
| Purpose of the data                                                                          | Calculation of baseline and project emissions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Comments                                                                                     | This corresponds to the assumptions made for the Korat Waste to Energy project, a registered AM0022 project in Thailand                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|                  |                    |
|------------------|--------------------|
| Data / Parameter | ECH4_NAWTF         |
| Data unit        | tCO <sub>2</sub> e |

|                                                                                              |                                                                                                                                                 |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Description                                                                                  | Methane emitted from UASB digesters                                                                                                             |
| Source of data                                                                               | IPCC default value                                                                                                                              |
| Value applied:                                                                               | 0                                                                                                                                               |
| Justification of choice of data or description of measurement methods and procedures applied | Value from registered project No 1040 (Korat Waste to Energy) is applied here due to lack of documentary evidence from the technology supplier. |
| Purpose of the data                                                                          | Calculation of baseline emissions                                                                                                               |
| Comments                                                                                     | -                                                                                                                                               |

|                                                                                              |                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | $R_{NAWTF}$                                                                                                                                                                                                                                                                              |
| Data unit                                                                                    | Fraction                                                                                                                                                                                                                                                                                 |
| Description                                                                                  | Total organic material removal efficiency of the new project wastewater facility.                                                                                                                                                                                                        |
| Source of data                                                                               | Calculated using COD concentration entering the project treatment facility and COD concentration leaving the treatment facility.                                                                                                                                                         |
| Value applied:                                                                               | 95.92%                                                                                                                                                                                                                                                                                   |
| Justification of choice of data or description of measurement methods and procedures applied | Based on actual measurement of COD removal over a 16 months period. Monitored COD in for UASB1 and UASB 2 in 2006, plus Jan to April of 2007.                                                                                                                                            |
| Purpose of the data                                                                          | Calculation of project emissions                                                                                                                                                                                                                                                         |
| Comments                                                                                     | This parameter is the monitored parameter ID.18 required by methodology. It is calculated based on following monitoring parameters ;<br>$(MCOD_{in:ID3} - MCOD_{out:ID4}) * 100 / MCOD_{in:ID3}$<br>The $R_{NAWTF}$ of the whole system is the average $R_{NAWTF}$ from UASB no.1 and 2. |

|                                                                                              |                                    |
|----------------------------------------------------------------------------------------------|------------------------------------|
| Data / Parameter                                                                             | EF                                 |
| Data unit                                                                                    | tCO <sub>2</sub> /TJ               |
| Description                                                                                  | Carbon emission factor of fuel oil |
| Source of data                                                                               | IPCC 2006                          |
| Value applied:                                                                               | 77.367                             |
| Justification of choice of data or description of measurement methods and procedures applied | Default value                      |
| Purpose of the data                                                                          | Calculation of baseline emissions  |
| Comments                                                                                     | -                                  |

|                                                                                              |                                   |
|----------------------------------------------------------------------------------------------|-----------------------------------|
| Data / Parameter                                                                             | NCV                               |
| Data unit                                                                                    | TJ/t                              |
| Description                                                                                  | Net calorific value of fuel oil   |
| Source of data                                                                               | IPCC 2006                         |
| Value applied:                                                                               | 0.0404                            |
| Justification of choice of data or description of measurement methods and procedures applied | Default value.                    |
| Purpose of the data                                                                          | Calculation of baseline emissions |
| Comments                                                                                     | -                                 |

|                                                                                              |                                                                                                                   |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | Density of CH <sub>4</sub>                                                                                        |
| Data unit                                                                                    | kg CH <sub>4</sub> / Nm <sup>3</sup> CH <sub>4</sub>                                                              |
| 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 applied:                                                                               | 0.716                                                                                                             |
| Justification of choice of data or description of measurement methods and procedures applied | Default value                                                                                                     |
| Purpose of the data                                                                          | Calculation of project emissions                                                                                  |
| Comments                                                                                     | -                                                                                                                 |

|                                                                                              |                                                                                    |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| Data / Parameter                                                                             | Lagoon surface area                                                                |
| Data unit                                                                                    | Hectare                                                                            |
| Description                                                                                  | Total lagoon area                                                                  |
| Source of data                                                                               | Project developer                                                                  |
| Value applied:                                                                               | 16                                                                                 |
| Justification of choice of data or description of measurement methods and procedures applied | Facility operates approx. 34 lagoons. Surface area data from the project operator. |
| Purpose of the data                                                                          | Calculation of baseline emissions                                                  |
| Comments                                                                                     | -                                                                                  |

|                  |                  |
|------------------|------------------|
| Data / Parameter | Flare efficiency |
|------------------|------------------|

|                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data unit                                                                                    | %                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Description                                                                                  | Flare efficiency for open flare                                                                                                                                                                                                                                                                                                                                                                                                                |
| Source of data                                                                               | Tool to determine project emissions from flaring gases containing methane                                                                                                                                                                                                                                                                                                                                                                      |
| Value applied:                                                                               | 50                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Justification of choice of data or description of measurement methods and procedures applied | Default value determined in accordance with the tool to determine project emissions from flaring gases containing methane. This figure corresponds also with the figure used by registered project activity No 1040 and the observation of other flare parameters leading to the selection of a 50% default efficiency as flare is detected for more than 20 minutes during every hour at a temperature of 850 degree Celsius during the hour. |
| Purpose of the data                                                                          | Calculation of project emissions                                                                                                                                                                                                                                                                                                                                                                                                               |
| Comments                                                                                     | -                                                                                                                                                                                                                                                                                                                                                                                                                                              |

### 3.2 Data and Parameters Monitored

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                   |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--|------------------------|-----------|------------------------|---------|-----|-----|------|--------|--------|------------|-------------|-------------|----------|------|------|-------------------|---------|---------|
| Data / Parameter                                                | AM0022 ID1<br>Wastewater flows entering the project treatment facility                                                                                                                                                                                                                                                                                            |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Data unit                                                       | m <sup>3</sup> /year                                                                                                                                                                                                                                                                                                                                              |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Description                                                     | The volume of wastewater flows entering into the new anaerobic digestion system                                                                                                                                                                                                                                                                                   |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Source of data                                                  | Wastewater flow meter FM3, FM5                                                                                                                                                                                                                                                                                                                                    |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Description of measurement methods and procedures to be applied | The volumetric flow meters are installed with totalized flow transmitter.                                                                                                                                                                                                                                                                                         |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Frequency of monitoring/recording                               | The wastewater flow is continuously monitored and recorded in log sheet on daily basis.                                                                                                                                                                                                                                                                           |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>1,461,603</td></tr><tr><td>01-Jan-13 to 31-Dec-13</td><td>893,902</td></tr></table>                                                                                                                                                                                                                                 |             |  | 01-Jan-12 to 31-Dec-12 | 1,461,603 | 01-Jan-13 to 31-Dec-13 | 893,902 |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| 01-Jan-12 to 31-Dec-12                                          | 1,461,603                                                                                                                                                                                                                                                                                                                                                         |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| 01-Jan-13 to 31-Dec-13                                          | 893,902                                                                                                                                                                                                                                                                                                                                                           |             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Monitoring equipment                                            | <table><tr><td>Meter name</td><td>FM3</td><td>FM5</td></tr><tr><td>Brand</td><td>E+H</td><td>E+H</td></tr><tr><td>Type</td><td>Promag</td><td>Promag</td></tr><tr><td>Serial no.</td><td>6B00EB20000</td><td>6B00E920000</td></tr><tr><td>Accuracy</td><td>0.5%</td><td>0.5%</td></tr><tr><td>Calibration Freq.</td><td>3 years</td><td>3 years</td></tr></table> |             |  | Meter name             | FM3       | FM5                    | Brand   | E+H | E+H | Type | Promag | Promag | Serial no. | 6B00EB20000 | 6B00E920000 | Accuracy | 0.5% | 0.5% | Calibration Freq. | 3 years | 3 years |
| Meter name                                                      | FM3                                                                                                                                                                                                                                                                                                                                                               | FM5         |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Brand                                                           | E+H                                                                                                                                                                                                                                                                                                                                                               | E+H         |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Type                                                            | Promag                                                                                                                                                                                                                                                                                                                                                            | Promag      |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Serial no.                                                      | 6B00EB20000                                                                                                                                                                                                                                                                                                                                                       | 6B00E920000 |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Accuracy                                                        | 0.5%                                                                                                                                                                                                                                                                                                                                                              | 0.5%        |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                           | 3 years     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |

|                                |                                                                     |                                     |                                     |
|--------------------------------|---------------------------------------------------------------------|-------------------------------------|-------------------------------------|
|                                | Calibration record                                                  | 14-Oct-11<br>07-Dec-12<br>09-May-14 | 14-Oct-11<br>07-Dec-12<br>09-May-14 |
| QA/QC procedures to be applied | The flow meters are calibrated at least once every 3 years.         |                                     |                                     |
| Purpose of the data            | Calculation of baseline and project emissions                       |                                     |                                     |
| Calculation method             | Summation of totalized volume of wastewater counted by FM3 and FM5. |                                     |                                     |
| Comments                       | -                                                                   |                                     |                                     |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--|------------------------|-----------|------------------------|---------|-----|-----|------|--------|--------|------------|-------------|-------------|----------|------|------|-------------------|---------|---------|--------------------|-------------------------------------|-------------------------------------|
| Data / Parameter                                                | AM0022 ID 2<br>Wastewater flows leaving the project treatment facility                                                                                                                                                                                                                                                                                                                                                                                                                            |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Data unit                                                       | m <sup>3</sup> /year                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Description                                                     | The volume of wastewater flows leaving the new anaerobic digestion system                                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Source of data                                                  | Established using ID 1 and assuming hydrological balance.                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Description of measurement methods and procedures to be applied | Assumed hydrological balance and using metered data from ID 1.                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Frequency of monitoring/recording                               | The wastewater flow is continuously monitored and recorded in log sheet on daily basis.                                                                                                                                                                                                                                                                                                                                                                                                           |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>1,461,603</td></tr><tr><td>01-Jan-13 to 31-Dec-13</td><td>893,902</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                 |                                     |  | 01-Jan-12 to 31-Dec-12 | 1,461,603 | 01-Jan-13 to 31-Dec-13 | 893,902 |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| 01-Jan-12 to 31-Dec-12                                          | 1,461,603                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| 01-Jan-13 to 31-Dec-13                                          | 893,902                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Monitoring equipment                                            | <table><tr><td>Meter name</td><td>FM3</td><td>FM5</td></tr><tr><td>Brand</td><td>E+H</td><td>E+H</td></tr><tr><td>Type</td><td>Promag</td><td>Promag</td></tr><tr><td>Serial no.</td><td>6B00EB20000</td><td>6B00E920000</td></tr><tr><td>Accuracy</td><td>0.5%</td><td>0.5%</td></tr><tr><td>Calibration Freq.</td><td>3 years</td><td>3 years</td></tr><tr><td>Calibration record</td><td>14-Oct-11<br/>07-Dec-12<br/>09-May-14</td><td>14-Oct-11<br/>07-Dec-12<br/>09-May-14</td></tr></table> |                                     |  | Meter name             | FM3       | FM5                    | Brand   | E+H | E+H | Type | Promag | Promag | Serial no. | 6B00EB20000 | 6B00E920000 | Accuracy | 0.5% | 0.5% | Calibration Freq. | 3 years | 3 years | Calibration record | 14-Oct-11<br>07-Dec-12<br>09-May-14 | 14-Oct-11<br>07-Dec-12<br>09-May-14 |
| Meter name                                                      | FM3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | FM5                                 |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Brand                                                           | E+H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | E+H                                 |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Type                                                            | Promag                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Promag                              |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Serial no.                                                      | 6B00EB20000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 6B00E920000                         |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Accuracy                                                        | 0.5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.5%                                |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3 years                             |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Calibration record                                              | 14-Oct-11<br>07-Dec-12<br>09-May-14                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 14-Oct-11<br>07-Dec-12<br>09-May-14 |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| QA/QC procedures to be applied                                  | The flow meters are calibrated at least once every 3 years.                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Purpose of the data                                             | Calculation of baseline and project emissions                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                     |  |                        |           |                        |         |     |     |      |        |        |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |

|                    |                                                                     |
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| Calculation method | Summation of totalized volume of wastewater counted by FM3 and FM5. |
| Comments           | -                                                                   |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                          |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------|------------------------|----------|------|------------|------------|-------|----------|------|-------------------|---------|--------------------|------------------------|
| Data / Parameter                                                | AM0022 ID 3<br>Wastewater organic material concentration entering the project treatment facility                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Data unit                                                       | kg COD / m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                  |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Description                                                     | COD concentration of the wastewater entering the new anaerobic digestion system                                                                                                                                                                                                                                                                                                          |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Source of data                                                  | Wastewater analysis result                                                                                                                                                                                                                                                                                                                                                               |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Description of measurement methods and procedures to be applied | The COD content in wastewater is analyzed using a colorimetric method by the on-site laboratory.                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Frequency of monitoring/recording                               | The analysis is carried out at least once a day for every operational day.                                                                                                                                                                                                                                                                                                               |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Value monitored:                                                | <table border="1"> <tr> <td>01-Jan-12 to 31-Dec-12</td><td>16.999</td></tr> <tr> <td>01-Jan-13 to 31-Dec-13</td><td>21.463</td></tr> </table>                                                                                                                                                                                                                                            | 01-Jan-12 to 31-Dec-12 | 16.999            | 01-Jan-13 to 31-Dec-13 | 21.463   |      |            |            |       |          |      |                   |         |                    |                        |
| 01-Jan-12 to 31-Dec-12                                          | 16.999                                                                                                                                                                                                                                                                                                                                                                                   |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| 01-Jan-13 to 31-Dec-13                                          | 21.463                                                                                                                                                                                                                                                                                                                                                                                   |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Monitoring equipment                                            | <table border="1"> <tr> <td>Meter name</td><td>Spectrophotometer</td></tr> <tr> <td>Brand</td><td>Lovibond</td></tr> <tr> <td>Type</td><td>Tintometer</td></tr> <tr> <td>Serial no.</td><td>38397</td></tr> <tr> <td>Accuracy</td><td>3.5%</td></tr> <tr> <td>Calibration Freq.</td><td>3 years</td></tr> <tr> <td>Calibration record</td><td>01-Nov-10<br/>24-Aug-13</td></tr> </table> | Meter name             | Spectrophotometer | Brand                  | Lovibond | Type | Tintometer | Serial no. | 38397 | Accuracy | 3.5% | Calibration Freq. | 3 years | Calibration record | 01-Nov-10<br>24-Aug-13 |
| Meter name                                                      | Spectrophotometer                                                                                                                                                                                                                                                                                                                                                                        |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Brand                                                           | Lovibond                                                                                                                                                                                                                                                                                                                                                                                 |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Type                                                            | Tintometer                                                                                                                                                                                                                                                                                                                                                                               |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Serial no.                                                      | 38397                                                                                                                                                                                                                                                                                                                                                                                    |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Accuracy                                                        | 3.5%                                                                                                                                                                                                                                                                                                                                                                                     |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                                                  |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calibration record                                              | 01-Nov-10<br>24-Aug-13                                                                                                                                                                                                                                                                                                                                                                   |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| QA/QC procedures to be applied                                  | The spectrophotometer is calibrated at least once every 3 years.                                                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Purpose of the data                                             | Calculation of baseline and project emissions                                                                                                                                                                                                                                                                                                                                            |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calculation method                                              | -                                                                                                                                                                                                                                                                                                                                                                                        |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Comments                                                        | -                                                                                                                                                                                                                                                                                                                                                                                        |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |

|                  |                                                                                                 |
|------------------|-------------------------------------------------------------------------------------------------|
| Data / Parameter | AM0022 ID 4<br>Wastewater organic material concentration leaving the project treatment facility |
|------------------|-------------------------------------------------------------------------------------------------|

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                               |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------|------------------------|----------|------|------------|------------|-------|----------|------|-------------------|---------|--------------------|------------------------|
| Data unit                                                       | kg COD / m <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                       |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Description                                                     | COD concentration of the wastewater leaving the new anaerobic digestion system                                                                                                                                                                                                                                                                                                |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Source of data                                                  | Wastewater analysis result                                                                                                                                                                                                                                                                                                                                                    |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Description of measurement methods and procedures to be applied | The COD content in wastewater is analyzed using a colorimetric method by the on-site laboratory.                                                                                                                                                                                                                                                                              |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Frequency of monitoring/recording                               | The analysis is carried out at least once a day for every operational day.                                                                                                                                                                                                                                                                                                    |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Value monitored:                                                | <table> <tr> <td>01-Jan-12 to 31-Dec-12</td><td>0.968</td></tr> <tr> <td>01-Jan-13 to 31-Dec-13</td><td>1.561</td></tr> </table>                                                                                                                                                                                                                                              | 01-Jan-12 to 31-Dec-12 | 0.968             | 01-Jan-13 to 31-Dec-13 | 1.561    |      |            |            |       |          |      |                   |         |                    |                        |
| 01-Jan-12 to 31-Dec-12                                          | 0.968                                                                                                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| 01-Jan-13 to 31-Dec-13                                          | 1.561                                                                                                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Monitoring equipment                                            | <table> <tr> <td>Meter name</td><td>Spectrophotometer</td></tr> <tr> <td>Brand</td><td>Lovibond</td></tr> <tr> <td>Type</td><td>Tintometer</td></tr> <tr> <td>Serial no.</td><td>38397</td></tr> <tr> <td>Accuracy</td><td>3.5%</td></tr> <tr> <td>Calibration Freq.</td><td>3 years</td></tr> <tr> <td>Calibration record</td><td>01-Nov-10<br/>24-Aug-13</td></tr> </table> | Meter name             | Spectrophotometer | Brand                  | Lovibond | Type | Tintometer | Serial no. | 38397 | Accuracy | 3.5% | Calibration Freq. | 3 years | Calibration record | 01-Nov-10<br>24-Aug-13 |
| Meter name                                                      | Spectrophotometer                                                                                                                                                                                                                                                                                                                                                             |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Brand                                                           | Lovibond                                                                                                                                                                                                                                                                                                                                                                      |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Type                                                            | Tintometer                                                                                                                                                                                                                                                                                                                                                                    |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Serial no.                                                      | 38397                                                                                                                                                                                                                                                                                                                                                                         |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Accuracy                                                        | 3.5%                                                                                                                                                                                                                                                                                                                                                                          |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                                       |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calibration record                                              | 01-Nov-10<br>24-Aug-13                                                                                                                                                                                                                                                                                                                                                        |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| QA/QC procedures to be applied                                  | The spectrophotometer is calibrated at least once every 3 years.                                                                                                                                                                                                                                                                                                              |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Purpose of the data                                             | Calculation of project emissions                                                                                                                                                                                                                                                                                                                                              |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Calculation method                                              | -                                                                                                                                                                                                                                                                                                                                                                             |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |
| Comments                                                        | -                                                                                                                                                                                                                                                                                                                                                                             |                        |                   |                        |          |      |            |            |       |          |      |                   |         |                    |                        |

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| Data / Parameter                                                | AM0022 ID 5<br>Volume of biogas sent to facility heaters                            |
| Data unit                                                       | Nm <sup>3</sup>                                                                     |
| Description                                                     | Volume of biogas sent to facility heaters                                           |
| Source of data                                                  | Biogas flow meter, GM4 and GM5                                                      |
| Description of measurement methods and procedures to be applied | The biogas flow meters are installed with totalized flow transmitter.               |
| Frequency of monitoring/recording                               | The biogas flow is continuously monitored and recorded in log sheet on daily basis. |
| Value monitored:                                                |                                                                                     |

|                                | 01-Jan-12 to 31-Dec-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 16,263,200                          |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------|--------------------|--------------------|-------|-----|-----|------|----------------|---------------|------------|-------------|-------------|----------|------|------|-------------------|---------|---------|--------------------|-------------------------------------|-------------------------------------|
|                                | 01-Jan-13 to 31-Dec-13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 12,651,318                          |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Monitoring equipment           | <table> <tr> <th>Meter name</th><th>GM4<br/>(prev. GM3)</th><th>GM5<br/>(prev. GM4)</th></tr> <tr> <td>Brand</td><td>E+H</td><td>E+H</td></tr> <tr> <td>Type</td><td>Proline T-mass</td><td>ProlineT-mass</td></tr> <tr> <td>Serial no.</td><td>9B09BD02000</td><td>AA083102000</td></tr> <tr> <td>Accuracy</td><td>1.5%</td><td>1.5%</td></tr> <tr> <td>Calibration Freq.</td><td>3 years</td><td>3 years</td></tr> <tr> <td>Calibration record</td><td>24-Jun-11<br/>01-Nov-12<br/>09-May-14</td><td>23-Jun-11<br/>01-Nov-12<br/>09-May-14</td></tr> </table> |                                     | Meter name | GM4<br>(prev. GM3) | GM5<br>(prev. GM4) | Brand | E+H | E+H | Type | Proline T-mass | ProlineT-mass | Serial no. | 9B09BD02000 | AA083102000 | Accuracy | 1.5% | 1.5% | Calibration Freq. | 3 years | 3 years | Calibration record | 24-Jun-11<br>01-Nov-12<br>09-May-14 | 23-Jun-11<br>01-Nov-12<br>09-May-14 |
| Meter name                     | GM4<br>(prev. GM3)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | GM5<br>(prev. GM4)                  |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Brand                          | E+H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | E+H                                 |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Type                           | Proline T-mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ProlineT-mass                       |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Serial no.                     | 9B09BD02000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | AA083102000                         |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Accuracy                       | 1.5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.5%                                |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Calibration Freq.              | 3 years                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 3 years                             |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Calibration record             | 24-Jun-11<br>01-Nov-12<br>09-May-14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 23-Jun-11<br>01-Nov-12<br>09-May-14 |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| QA/QC procedures to be applied | The flow meter is calibrated at least once every 3 years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                     |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Purpose of the data            | Calculation of baseline emissions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                     |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Calculation method             | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                     |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |
| Comments                       | <ul style="list-style-type: none"> <li>The deviation 1 is applied for monitored data of 2013 to remove the portion of biogas produced from CL3.</li> <li>The biogas used at steam boiler no.6 , 9 ,10 , 11 are excluded in the baseline emission reduction calculation as described in Deviation 2.</li> <li>The same from both deviations is included in Project emissions <math>E_{CH_4\_IC\_heat}</math>.</li> </ul>                                                                                                                                         |                                     |            |                    |                    |       |     |     |      |                |               |            |             |             |          |      |      |                   |         |         |                    |                                     |                                     |

|                                                                 |                                                                                                                                                             |
|-----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | AM0022 ID 8<br>F: Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility |
| Data unit                                                       | ton                                                                                                                                                         |
| Description                                                     | Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility                   |
| Source of data                                                  | Calculated using ID5, ID15, ID19                                                                                                                            |
| Description of measurement methods and procedures to be applied | -                                                                                                                                                           |
| Frequency of monitoring/recording                               | -                                                                                                                                                           |
| Value monitored:                                                |                                                                                                                                                             |

|                                |                                                                                                                                                                                                                                     |       |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|                                | 01-Jan-12 to 31-Dec-12                                                                                                                                                                                                              | 8,055 |
|                                | 01-Jan-13 to 31-Dec-13                                                                                                                                                                                                              | 6,146 |
| Monitoring equipment           | -                                                                                                                                                                                                                                   |       |
| QA/QC procedures to be applied | -                                                                                                                                                                                                                                   |       |
| Purpose of the data            | Calculation of baseline emissions                                                                                                                                                                                                   |       |
| Calculation method             | <p>Calculated based on the net calorific value (NCV) of biogas.</p> <p>The quantity of biogas used by the boiler is multiplied by NCV of biogas, and then divided by NCV of heavy fuel oil to get the volume of heavy fuel oil.</p> |       |
| Comments                       | -                                                                                                                                                                                                                                   |       |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------|----------------|------------------------|---------|------|----------------|------------|-------------|----------|------|-------------------|---------|--------------------|------------------------|------------|-----------|
| Data / Parameter                                                | AM0022 ID 9<br>Biogas sent to flares (V1)                                                                                                                                                                                                                                                                                                                                                                                         |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Data unit                                                       | Nm <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Description                                                     | Surplus biogas sent to flare system (wet basis)                                                                                                                                                                                                                                                                                                                                                                                   |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Source of data                                                  | Biogas flow meter, GM6                                                                                                                                                                                                                                                                                                                                                                                                            |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Description of measurement methods and procedures to be applied | The biogas flow meter is installed with totalized flow transmitter.                                                                                                                                                                                                                                                                                                                                                               |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Frequency of monitoring/recording                               | The biogas flow is continuously monitored and recorded in log sheet on daily basis.                                                                                                                                                                                                                                                                                                                                               |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>199,868</td></tr><tr><td>01-Jan-13 to 31-Dec-13</td><td>540,046</td></tr></table>                                                                                                                                                                                                                                                                                                   |  | 01-Jan-12 to 31-Dec-12 | 199,868        | 01-Jan-13 to 31-Dec-13 | 540,046 |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| 01-Jan-12 to 31-Dec-12                                          | 199,868                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| 01-Jan-13 to 31-Dec-13                                          | 540,046                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Monitoring equipment                                            | <table><tr><td>Meter name</td><td>GM6 (prev.GM4)</td></tr><tr><td>Brand</td><td>E+H</td></tr><tr><td>Type</td><td>Prolone T-mass</td></tr><tr><td>Serial no.</td><td>AA083102000</td></tr><tr><td>Accuracy</td><td>1.5%</td></tr><tr><td>Calibration Freq.</td><td>3 years</td></tr><tr><td>Calibration record</td><td>23-Jun-11<br/>01-Nov-12</td></tr></table><br><table><tr><td>Meter name</td><td>GM6 (new)</td></tr></table> |  | Meter name             | GM6 (prev.GM4) | Brand                  | E+H     | Type | Prolone T-mass | Serial no. | AA083102000 | Accuracy | 1.5% | Calibration Freq. | 3 years | Calibration record | 23-Jun-11<br>01-Nov-12 | Meter name | GM6 (new) |
| Meter name                                                      | GM6 (prev.GM4)                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Brand                                                           | E+H                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Type                                                            | Prolone T-mass                                                                                                                                                                                                                                                                                                                                                                                                                    |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Serial no.                                                      | AA083102000                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Accuracy                                                        | 1.5%                                                                                                                                                                                                                                                                                                                                                                                                                              |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Calibration record                                              | 23-Jun-11<br>01-Nov-12                                                                                                                                                                                                                                                                                                                                                                                                            |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |
| Meter name                                                      | GM6 (new)                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                        |                |                        |         |      |                |            |             |          |      |                   |         |                    |                        |            |           |

|                                |                                                           |                |  |
|--------------------------------|-----------------------------------------------------------|----------------|--|
|                                | Brand                                                     | E+H            |  |
|                                | Type                                                      | Prolone T-mass |  |
|                                | Serial no.                                                | H1120802000    |  |
|                                | Accuracy                                                  | 1.5%           |  |
|                                | Calibration Freq.                                         | 3 years        |  |
|                                | Calibration record                                        | 08-May-14      |  |
| QA/QC procedures to be applied | The flow meter is calibrated at least once every 3 years. |                |  |
| Purpose of the data            | Calculation of project emissions                          |                |  |
| Calculation method             | -                                                         |                |  |
| Comments                       | -                                                         |                |  |

|                                                                 |                                                                                                                                                                                                                                                                                                                                                          |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
|-----------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------|---------------------|------------------------|-------|------|----------|------------|------|----------|----|-------------------|---------|--------------------|------------------------|
| Data / Parameter                                                | AM0022 ID 11<br>Biogas methane concentration                                                                                                                                                                                                                                                                                                             |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Data unit                                                       | %                                                                                                                                                                                                                                                                                                                                                        |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Description                                                     | Methane concentration in biogas                                                                                                                                                                                                                                                                                                                          |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Source of data                                                  | Biogas analyzer                                                                                                                                                                                                                                                                                                                                          |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Description of measurement methods and procedures to be applied | The inline gas analyzers are installed for continuous measurement of the methane content in the biogas. The daily average value is used for reporting.                                                                                                                                                                                                   |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Frequency of monitoring/recording                               | The gas analyzers are continuously monitored and summarized on daily basis.                                                                                                                                                                                                                                                                              |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>54.87</td></tr><tr><td>01-Jan-13 to 31-Dec-13</td><td>53.73</td></tr></table>                                                                                                                                                                                                                              |  | 01-Jan-12 to 31-Dec-12 | 54.87               | 01-Jan-13 to 31-Dec-13 | 53.73 |      |          |            |      |          |    |                   |         |                    |                        |
| 01-Jan-12 to 31-Dec-12                                          | 54.87                                                                                                                                                                                                                                                                                                                                                    |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| 01-Jan-13 to 31-Dec-13                                          | 53.73                                                                                                                                                                                                                                                                                                                                                    |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Monitoring equipment                                            | <table><tr><td>Meter name</td><td>Inline gas analyzer</td></tr><tr><td>Brand</td><td>VISIT</td></tr><tr><td>Type</td><td>VISIT 04</td></tr><tr><td>Serial no.</td><td>0505</td></tr><tr><td>Accuracy</td><td>2%</td></tr><tr><td>Calibration Freq.</td><td>3 years</td></tr><tr><td>Calibration record</td><td>21-Dec-11<br/>19-Oct-12</td></tr></table> |  | Meter name             | Inline gas analyzer | Brand                  | VISIT | Type | VISIT 04 | Serial no. | 0505 | Accuracy | 2% | Calibration Freq. | 3 years | Calibration record | 21-Dec-11<br>19-Oct-12 |
| Meter name                                                      | Inline gas analyzer                                                                                                                                                                                                                                                                                                                                      |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Brand                                                           | VISIT                                                                                                                                                                                                                                                                                                                                                    |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Type                                                            | VISIT 04                                                                                                                                                                                                                                                                                                                                                 |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Serial no.                                                      | 0505                                                                                                                                                                                                                                                                                                                                                     |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Accuracy                                                        | 2%                                                                                                                                                                                                                                                                                                                                                       |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Calibration Freq.                                               | 3 years                                                                                                                                                                                                                                                                                                                                                  |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |
| Calibration record                                              | 21-Dec-11<br>19-Oct-12                                                                                                                                                                                                                                                                                                                                   |  |                        |                     |                        |       |      |          |            |      |          |    |                   |         |                    |                        |

|                                |                                                                            |              |              |
|--------------------------------|----------------------------------------------------------------------------|--------------|--------------|
|                                | Meter name                                                                 | Gas analyzer |              |
|                                | Brand                                                                      | ABB          |              |
|                                | Type                                                                       | EL 1020      |              |
|                                | Serial no.                                                                 | 3.241376.5   |              |
|                                | Accuracy                                                                   | 2%           |              |
|                                | Calibration Freq.                                                          | 3 years      |              |
|                                | Calibration record                                                         | 21-Dec-11    |              |
|                                |                                                                            |              |              |
|                                | Meter name                                                                 | Gas analyzer | Gas analyzer |
|                                | Brand                                                                      | ABB          | ABB          |
|                                | Type                                                                       | EL 3040      | EL 3040      |
|                                | Serial no.                                                                 | 3.352195.2   | 3.352191.2   |
|                                | Accuracy                                                                   | 1%           | 1%           |
|                                | Calibration Freq.                                                          | 3 years      | 3 years      |
|                                | Calibration record                                                         | 09-May-14    | 09-May-14    |
| QA/QC procedures to be applied | The gas analyzer is calibrated at least once every 3 years.                |              |              |
| Purpose of the data            | Calculation of project emissions                                           |              |              |
| Calculation method             | -                                                                          |              |              |
| Comments                       | The deviation 3 is applied since the data is not available on daily basis. |              |              |

|                                                                 |                                                                                                                          |  |                        |     |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--|------------------------|-----|
| Data / Parameter                                                | AM0022 ID 12<br>Project emissions from flaring of the residual gas stream (PE <sub>flare</sub> )                         |  |                        |     |
| Data unit                                                       | t CO <sub>2</sub> e                                                                                                      |  |                        |     |
| Description                                                     | Project emissions from flaring of the residual gas stream                                                                |  |                        |     |
| Source of data                                                  | Calculated based on the flared gas amount and 0% flare efficiency.                                                       |  |                        |     |
| Description of measurement methods and procedures to be applied | The PE <sub>flare</sub> is calculated as per “Tool to determine project emissions from flaring gases containing methane” |  |                        |     |
| Frequency of monitoring/recording                               | -                                                                                                                        |  |                        |     |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>819</td></tr></table>                                                      |  | 01-Jan-12 to 31-Dec-12 | 819 |
| 01-Jan-12 to 31-Dec-12                                          | 819                                                                                                                      |  |                        |     |

|                                |                                                      |       |
|--------------------------------|------------------------------------------------------|-------|
|                                | 01-Jan-13 to 31-Dec-13                               | 2,583 |
| Monitoring equipment           | -                                                    |       |
| QA/QC procedures to be applied | -                                                    |       |
| Purpose of the data            | Calculation of project emissions                     |       |
| Calculation method             | Using data measured with meter GM6 (previously GM4). |       |
| Comments                       | -                                                    |       |

|                                                                 |                                                                                                                     |  |                        |   |                        |   |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|--|------------------------|---|------------------------|---|
| Data / Parameter                                                | AM0022 ID 13<br>Amount of chemical oxidizing agents entering system boundary                                        |  |                        |   |                        |   |
| Data unit                                                       | Tons / m <sup>3</sup>                                                                                               |  |                        |   |                        |   |
| Description                                                     | Amount of chemical oxidizing agents entering system boundary                                                        |  |                        |   |                        |   |
| Source of data                                                  | Default value                                                                                                       |  |                        |   |                        |   |
| Description of measurement methods and procedures to be applied | -                                                                                                                   |  |                        |   |                        |   |
| Frequency of monitoring/recording                               | -                                                                                                                   |  |                        |   |                        |   |
| Value monitored:                                                | <table><tr><td>01-Jan-12 to 31-Dec-12</td><td>0</td></tr><tr><td>01-Jan-13 to 31-Dec-13</td><td>0</td></tr></table> |  | 01-Jan-12 to 31-Dec-12 | 0 | 01-Jan-13 to 31-Dec-13 | 0 |
| 01-Jan-12 to 31-Dec-12                                          | 0                                                                                                                   |  |                        |   |                        |   |
| 01-Jan-13 to 31-Dec-13                                          | 0                                                                                                                   |  |                        |   |                        |   |
| Monitoring equipment                                            | -                                                                                                                   |  |                        |   |                        |   |
| QA/QC procedures to be applied                                  | -                                                                                                                   |  |                        |   |                        |   |
| Purpose of the data                                             | -                                                                                                                   |  |                        |   |                        |   |
| Calculation method                                              | -                                                                                                                   |  |                        |   |                        |   |
| Comments                                                        | No oxidizing agents are used. The wastewater from the last lagoon is used for balancing the pH of the wastewater.   |  |                        |   |                        |   |

|                  |                                                                                      |  |
|------------------|--------------------------------------------------------------------------------------|--|
| Data / Parameter | AM0022 ID 15<br>Heating system combustion efficiency                                 |  |
| Data unit        | %                                                                                    |  |
| Description      | Proportion of biogas combusted by heating system facility (hot oil and steam boiler) |  |
| Source of data   | Default value as no supplier specification is available.                             |  |

|                                                                 |                                                                       |
|-----------------------------------------------------------------|-----------------------------------------------------------------------|
| Description of measurement methods and procedures to be applied | Heating system efficiency was determined during commissioning.        |
| Frequency of monitoring/recording                               | -                                                                     |
| Value monitored:                                                | 98.5                                                                  |
| Monitoring equipment                                            | -                                                                     |
| QA/QC procedures to be applied                                  | Calculation was conducted on the basis of standard industry practice. |
| Purpose of the data                                             | -                                                                     |
| Calculation method                                              | -                                                                     |
| Comments                                                        | -                                                                     |

|                                                                 |                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data / Parameter                                                | AM0022 ID 16<br>Flow of wastewater directly to the current wastewater treatment system                                                                                                                                                                 |
| Data unit                                                       | m <sup>3</sup>                                                                                                                                                                                                                                         |
| Description                                                     | Volume of wastewater directly to the current wastewater treatment system and bypassing the new wastewater facilities                                                                                                                                   |
| Source of data                                                  | Default value from registered PD                                                                                                                                                                                                                       |
| Description of measurement methods and procedures to be applied | No wastewater is sent directly to the current facility. Even if wastewater is sent directly to any facility, it will have no affect on the emission reduction estimate as baseline emissions are equal to project emissions for such a case.           |
| Frequency of monitoring/recording                               | -                                                                                                                                                                                                                                                      |
| Value monitored:                                                | 0                                                                                                                                                                                                                                                      |
| Monitoring equipment                                            | -                                                                                                                                                                                                                                                      |
| QA/QC procedures to be applied                                  | -                                                                                                                                                                                                                                                      |
| Purpose of the data                                             | -                                                                                                                                                                                                                                                      |
| Calculation method                                              | -                                                                                                                                                                                                                                                      |
| Comments                                                        | No wastewater is sent directly to the current facilities. Even if wastewater is sent directly to any facilities, it will have no effect on the estimated emission reduction because baseline emissions are equal to project emissions for such a case. |

|                  |                                              |
|------------------|----------------------------------------------|
| Data / Parameter | AM0022 ID 17<br>Loss of biogas from pipeline |
| Data unit        | %                                            |
| Description      | Loss of biogas from pipeline                 |

|                                                                 |                                                                                         |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Source of data                                                  | Estimated, spot checks using leakage in piping system                                   |
| Description of measurement methods and procedures to be applied | Integrity of biogas pipeline for losses is checked using mobile gas leak detector.      |
| Frequency of monitoring/recording                               | -                                                                                       |
| Value monitored:                                                | 0                                                                                       |
| Monitoring equipment                                            | -                                                                                       |
| QA/QC procedures to be applied                                  | Checks to be carried out to international standards if there is indication for leakage. |
| Purpose of the data                                             | -                                                                                       |
| Calculation method                                              | -                                                                                       |
| Comments                                                        | -                                                                                       |

|                                                                 |                                                                                            |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| Data / Parameter                                                | AM0022 ID 18<br>Organic material removed from wastewater facility                          |
| Data unit                                                       | t COD                                                                                      |
| Description                                                     | Organic material removed from wastewater facility                                          |
| Source of data                                                  | The record of excess sludge removed from truck scale at starch factory.                    |
| Description of measurement methods and procedures to be applied | The amount of excess sludge removed is weighed every time before leaving the project site. |
| Frequency of monitoring/recording                               | -                                                                                          |
| Value monitored:                                                | 0                                                                                          |
| Monitoring equipment                                            | -                                                                                          |
| QA/QC procedures to be applied                                  | -                                                                                          |
| Purpose of the data                                             | -                                                                                          |
| Calculation method                                              | -                                                                                          |
| Comments                                                        | No excess sludge is removed from UASB system.                                              |

|                                                                 |                                           |
|-----------------------------------------------------------------|-------------------------------------------|
| Data / Parameter                                                | AM0022 ID 19<br>Biogas calorific value    |
| Data unit                                                       | MJ/Nm <sup>3</sup>                        |
| Description                                                     | Calorific value of biogas                 |
| Source of data                                                  | Calculated from methane content in biogas |
| Description of measurement methods and procedures to be applied | -                                         |
| Frequency of monitoring/recording                               | -                                         |

|                                |                                                                 |       |
|--------------------------------|-----------------------------------------------------------------|-------|
| Value monitored:               |                                                                 |       |
|                                | 01-Jan-12 to 31-Dec-12                                          | 20.01 |
|                                | 01-Jan-13 to 31-Dec-13                                          | 19.63 |
| Monitoring equipment           | -                                                               |       |
| QA/QC procedures to be applied | -                                                               |       |
| Purpose of the data            | -                                                               |       |
| Calculation method             | The NCV of methane is multiplied by %CH <sub>4</sub> in biogas. |       |
| Comments                       | -                                                               |       |

### 3.3 Monitoring Plan

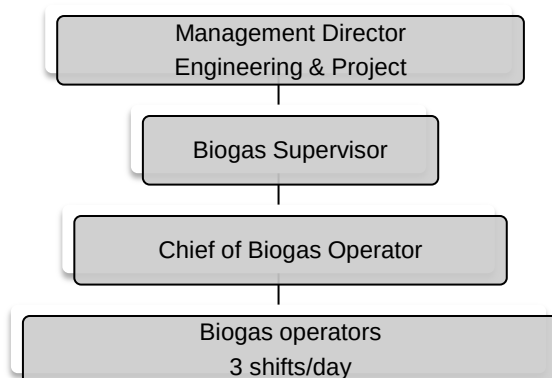
Section B of the PDD (application of the baseline and monitoring methodology) provides details on the calculation of emission reductions and the monitoring plan that is followed in the project activity. The emission reduction calculations and the monitoring plan are based on approved CDM methodology AM0022 version 4.

The wastewater treatment system operational and management systems have been certified under ISO 14001 version 2004 by UKAS. This certificate is valid from 16<sup>th</sup> Dec 2008 to 15<sup>th</sup> Dec 2014. This certificate ensures that requirements and procedures for parameter monitoring, data recording and data archiving for environmental management system of biogas section are well managed according to ISO14001 requirements.

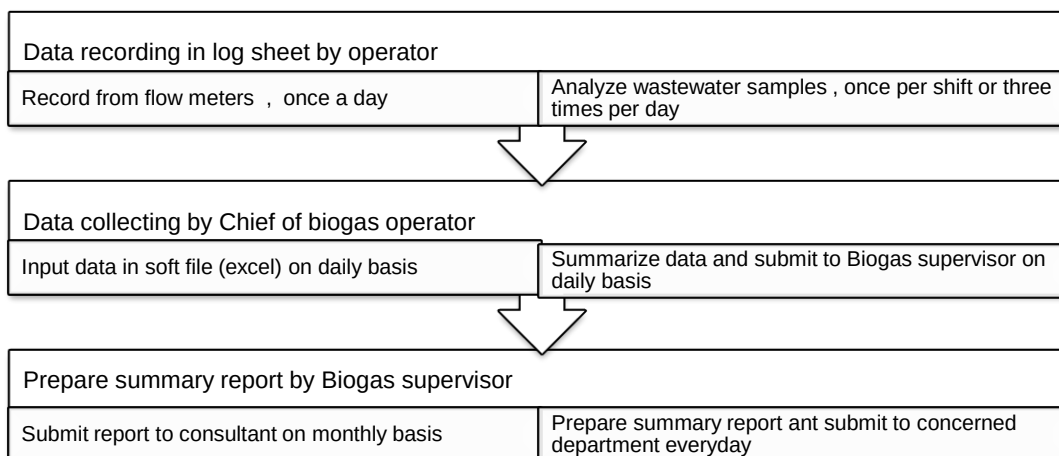
The plant operator carries out the daily operation recording and laboratory analysis. The monitored data is collected and recorded in the excel spreadsheet by chief of biogas operator. The report will be checked and approved by the plant supervisor. The summary reports are submitted to management on daily basis.

All equipment calibrations are controlled by the biogas plant supervisor. All documents are managed according to the requirements of ISO14001.

#### Organization structure



### Data Collection and management system



### Data storage and backup

- The original log sheets are collected and stored at biogas plant office by Chief of biogas operator.
- The data in excel format is stored at two computers at biogas plant. The backup of hard disk is done by IT department on monthly basis.
- The data submitted to consultant is stored and backup via consultant's internal server on monthly basis.

## 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

### 4.1 Baseline Emissions

The baseline scenario for the project is based on what would have happened in the absence of the project activities. In this case, the baseline scenario will be continued operation of the open lagoon system.

$$E_{BL} = E_{CH4\_lagoons\_BL} + E_{CO2\_heat\_BL} + E_{CO2\_power\_BL} \quad (Formula\ 8)$$

Where :

- $E_{BL}$  are the total baseline emissions (tCO<sub>2</sub>e)
- $E_{CH4\_lagoons\_BL}$  are the fugitive methane emissions from lagoons in the baseline case (tCO<sub>2</sub>e)
- $E_{CO2\_heat\_BL}$  are the CO<sub>2</sub> emissions from onsite heat displaced by biogas collected in the anaerobic treatment facility (tCO<sub>2</sub>e)

$E_{CO_2\_power\_BL}$  are the CO<sub>2</sub> emissions from onsite power generated from biogas collected in the anaerobic treatment facility (tCO<sub>2</sub>e)

The GWP<sub>CH<sub>4</sub></sub> for monitoring period in 2013 is changed from 21 to 25 kg CH<sub>4</sub> / kgCOD , as per reference from Annex 3 of EB69.

## 4.2 Project Emissions

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

$$E_{project} = E_{CH_4\_lagoons} + E_{CH_4\_NAWTF} + E_{CH_4\_IC+Leaks} \quad (Formula\ 1)$$

Where :

$E_{project}$  are the Total Project Emissions (tCO<sub>2</sub>e)  
 $E_{CH_4\_lagoons}$  are the fugitive methane emissions from lagoons from equation 2 (tCO<sub>2</sub>e)  
 $E_{CH_4\_NAWTF}$  are the fugitive methane emissions from the new anaerobic wastewater treatment facility (tCO<sub>2</sub>e)<sup>2</sup>  
 $E_{CH_4\_IC+Leaks}$  are the methane emissions from inefficient combustion and leaks (tCO<sub>2</sub>e)

$$E_{CH_4\_lagoons} = M_{lagoon\_anaerobic} * EF_{CH_4} * GWP_{CH_4} / 1000 \quad (Formula\ 2)$$

Where :

$E_{CH_4\_lagoons}$  is the methane emissions from the lagoons (tCO<sub>2</sub>e)  
 $M_{lagoon\_anaerobic}$  is the amount of organic material removed by anaerobic processes in the lagoon system (kgCOD)  
 $EF_{CH_4}$  is the methane emission factor (kg CH<sub>4</sub> / kgCOD).  
 $GWP_{CH_4}$  is the global warming potential of methane

$$E_{CH_4\_IC+Leak} = [\sum_r V_r * C_{CH_4\_r} * (1 - f_r) * GWP_{CH_4}] + PE_{flare} \quad (Formula\ 7)$$

Where :

$V_r$  is the biogas combustion process volume in route r (Nm<sup>3</sup>)  
 $C_{CH_4}$  is the methane concentration in biogas (tCH<sub>4</sub>/Nm<sup>3</sup>) to be measured on wet basis  
 $f_r$  is the proportion of biogas destroyed by combustion  
 $PE_{flare}$  are the project emissions from flaring of the residual gas stream (tCO<sub>2</sub>e)

The GWP<sub>CH<sub>4</sub></sub> for monitoring period in 2013 is changed from 21 to 25 kg CH<sub>4</sub> / kgCOD , as per reference from Annex 3 of EB69.

## 4.3 Leakage

<sup>2</sup> In accordance with AM0022, methane emissions from the reactor should be assessed and estimated based on measurements, technology supplier data and expert estimates. They may be disregarded if documented evidence for their insignificance is given. Registered project no 1040 (KWTE) determined that methane emissions from the reactor are not significant and thus disregarded here as well.

Leaks in the biogas system include leaks from the anaerobic digester and leaks from the biogas pipeline delivery system. The excess biogas is assumed to be flared at the installed flare at zero percent efficiency.

The leakage in biogas system is secured by engineering design of its system. The UASB reactor gas collection system consists of a gas-tight-concrete-coated gas dome. The delivery pipe to the boiler site is less than 2 km in length.

The pipeline system uses High Density Polyethylene (HDPE). The piping material, therefore, is appropriate and has chemical resistance to biogas. The leakage of biogas due to the pipeline system is, therefore, negligible in the project emissions calculations.

#### 4.4 Net GHG Emission Reductions and Removals

$$ER = E_{BL} - E_{project} \quad (Formula\ 12)$$

It must be verified this equation delivers a conservative estimate of emission reductions i.e. that the emissions of CH<sub>4</sub> from the lagoons in the baseline situation are not higher than the total emissions of biogas from the digester and the lagoons in the project situation. Therefore calculate using:

$$E_{CH_4\_lagoon\_BL} - (E_{CH_4\_lagoon} + E_{CH_4\_nawt} + E_{CH_4\_coll}) \quad (Formula\ 13)$$

Any positive difference between emissions of CH<sub>4</sub> from the lagoon and emissions from the digester and the lagoons in the project situation are to be deducted from the emission reduction estimate.

| Year                   | Net GHG emission reductions or removals (tCO <sub>2</sub> e) |
|------------------------|--------------------------------------------------------------|
| Year 2012              | 121,934.6                                                    |
| Year 2013              | 110,192.5                                                    |
| <b>Total (rounded)</b> | <b>231,127</b>                                               |

## APPENDIX 1 : ADDITIONAL INFORMATION

**Table 2 : Biogas consumption by additional boilers**

| Biogas Consumption at new steam boiler |                  |                  |                   |
|----------------------------------------|------------------|------------------|-------------------|
| Nm3 of biogas                          | Steam boiler # 6 | Steam boiler # 9 | Steam boiler # 10 |
| Jan'12                                 | 182,120          | 205,000          | -                 |
| Feb'12                                 | 179,040          | 186,341          | -                 |
| Mar'12                                 | 133,848          | 169,728          | 99,502            |
| Apr'12                                 | 161,047          | 176,651          | 72,183            |
| May'12                                 | 46,454           | 30,825           | 58,563            |
| Jun'12                                 | 204,986          | -                | 170,200           |
| Jul'12                                 | 212,054          | 6,243            | 223,740           |
| Aug'12                                 | 202,468          | 39,703           | 208,093           |
| Sep'12                                 | 190,442          | 60,469           | 184,760           |
| Oct'12                                 | 224,944          | -                | 226,294           |
| Nov'12                                 | 200,132          | 18,716           | 213,121           |
| Dec'12                                 | 138,782          | -                | 102,569           |

| Total 2012 | Total 2013 |
|------------|------------|
| 4,529,021  | 3,820,402  |

| Biogas Consumption at new steam boiler |                  |                  |                   |                   |
|----------------------------------------|------------------|------------------|-------------------|-------------------|
| Nm3 of biogas                          | Steam boiler # 6 | Steam boiler # 9 | Steam boiler # 10 | Steam boiler # 11 |
| Jan'13                                 | 92,295           | 148,613          | 81,914            | -                 |
| Feb'13                                 | 57,544           | 126,979          | 165,741           | -                 |
| Mar'13                                 | 125,656          | 193,800          | 61,599            | -                 |
| Apr'13                                 | 120,174          | 143,512          | -                 | -                 |
| May'13                                 | 101,324          | 157,941          | 44,717            | -                 |
| Jun'13                                 | 146,451          | 216,155          | -                 | -                 |
| Jul'13                                 | 90,409           | 107,435          | -                 | -                 |
| Aug'13                                 | 64,045           | 186,297          | -                 | -                 |
| Sep'13                                 | 93,352           | 117,929          | -                 | 31,012            |
| Oct'13                                 | 126,253          | 67,213           | -                 | 173,548           |
| Nov'13                                 | 57,559           | 17,401           | -                 | 298,237           |
| Dec'13                                 | 57,410           | -                | -                 | 347,886           |