Monitoring report form

(Version 04.0)

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

Gold Standard Monitoring report	
Title of the project activity	Bangkok Kamphaeng Saen East: Landfill Gas to Electricity Project
Reference number of the project activity	GS1371 (CDM Project Reference: 3462)
Version number of the monitoring report	4
Completion date of the monitoring report	02-02-2015
Registration date of the project activity	Gold Standard 27-08-2013 CDM registration 21-01-2011
Monitoring period number and duration of this monitoring period	Monitoring period number: 5 (follows CDM) Duration 01-10-2013 - 31-10-2014 (both dates inclusive)
Project participant(s)	Bangkok Greenpower Co., Ltd. Xentolar Holdings Limited. Sindicatum Carbon Capital Ltd.
Host Party(ies)	The Kingdom of Thailand
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	Sectoral Scope 13 - Waste Handling and Disposal Applied Methodology - ACM0001 "Flaring or use of landfill gas", Version 13.0.0
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	165,056 tCO_2e (Estimated ex-ante emission reduction pro rata with the annual ex-ante estimated from 01-10-2013 – 31-10-2014 (both dates inclusive))
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	401,167 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	N/A
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	656,182 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

Bangkok Kamphaeng Saen East: Landfill Gas to Electricity Project (hereinafter is referred as "The Project") extracts, captures and utilizes landfill gas (LFG) to generate electricity. The LFG is extracted and captured using Sindicatum Carbon Capital (ordered by Xentolar Holdings Limited, a project participant) proprietary LFG collection system and the electricity generated is exported to the Thailand electrical grid (Thai Grid).

Under the project activity, a fully integrated LFG collection system is installed and operated. When the yield of gas is insufficient to supply to the generators, or surplus LFG is available, due to engine maintenance or other site factors, LFG is sent to an enclosed ground flare where it is flared; thus minimising methane emissions and maximising carbon abatement. The annual emission reductions of the project activity indicated in the PDD are approximately 100,500 tCO_2e yearly over the first 7-year crediting period.

The construction of landfill gas extraction pipe & gas collection system commenced in July 2009 and commissioning on February 2010. The Pre-treatment and three flares were installed from October 2009 to January 2010. Landfill gas has been extracted and combusted by flare since February 2010. The physical installation of the first four engines and construction of the grid connection was completed by the end of March 2010. Following commissioning the project exported electricity to the Thai Grid from April 2010. An additional 2 engines were installed during April 2011 and commissioned during May 2011. A further 2 engines were installed during December 2011 and commissioned during January 2012.

Total emission reductions achieved in this monitoring period are **401,167 tCO_2e**.

A.2. Location of project activity

The Project is located in the Kingdom of Thailand, at T. Sasimhum, A. Kamphaeng Saen, Nakhon Pathom, 73140. The geographic coordinates of the project are: longitude 14°3'50.62"N and latitude 99°56'50.96"E

Figure A.2.1 Project coordinate and location

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
The Kingdom of Thailand (host)	Bangkok Greenpower Co., Ltd.	No
UK (Annex I)	Xentolar Holdings Limited	No
UK (Annex I)	Sindicatum Carbon Capital Ltd.	No

A.4. Reference of applied methodology and standardized baseline

- ACM0001 "Flaring or use of landfill gas" Version 13.0.0

And following methodological tools:

- "Emissions from solid waste disposal sites" Version 06.0.1
- "Combined tool to identify the baseline scenario and demonstrate additionality" Version 05.0.0
- "Project emissions from flaring" Version 02.0.0
- "Tool to calculate the emission factor for an electricity system" Version 3.0.0
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" Version 01.
- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" Version 02.0.0
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 02

Detailed information regarding these methodologies and tools please refer to UNFCCC methodology website.

A.5. Crediting period of project activity

A renewable 7 years crediting period was chosen for the project activity. The start date of the crediting period was 01/04/2012. The end date of the crediting period is same as CDM crediting period on 20/01/2018.

A.6. Contact information of responsible persons/ entities

Jay Mariyappan
Managing Director, Delivery
Sindicatum Sustainable Resources Group
80 Anson Road, #28-02
Fuji Xerox Towers
Singapore 079907

A.7. Eligibility of project activity

A.7.1 Reference of applied Gold Standard Version

The project activity applied the Gold Standard Version 2.2 which is comprising of:

- The Gold Standard Requirements Version 2.2
- The Gold Standard Toolkit Version 2.2

A.7.2 Scale of project activity

Project Type	Large	Small
	√	☐

A.7.3 Type of project activity

The project activity falls into the waste handling and disposal category**.**

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The project is extracting, capturing and utilizing landfill gas (LFG) from Kamphaeng Saen East Landfill to generate electricity. The electricity generated is exported to the Thai Grid. Whenever there is surplus LFG, due to engine maintenance or other site factors, LFG is sent to an enclosed ground flare where it is flared thus minimising methane emissions and maximising carbon abatement.

Landfill gas collection system:
High-density polyethylene (HDPE) horizontal collection pipes have been installed in the waste as an integral part of the tipping operation. These collection wells are augmented by additional horizontal and vertical collection wells. The collection pipes are connected via main carrier pipes to the LFG extraction plant and a negative pressure applied. The LFG, comprising approximately 50% methane and 50% carbon dioxide is used for power generation with any surplus gas flared. The SCC proprietary LFG system has been designed to optimise LFG recovery and utilisation and optimise carbon abatement, and is designed to overcome inherent problems associated with LFG projects in similar conditions.

The recovered LFG passes through the pre-treatment plant where moisture and particulates are removed prior to the power generating engines. The pre treatment plant is designed to ensure that the gas quality reaching the engines is in line with the manufacturer's requirements. A schematic layout of the pre treatment and utilisation plant is shown in Figure B.1-1 below. Power generation units have been installed in line with electrical infrastructure capacity and also to match the LFG

recovery profile. Sufficient flare capacity has been installed to ensure that any surplus LFG is flared if engine capacity is insufficient or during periods of maintenance or breakdown. The interface control and system management has been designed to allow real time adjustment of system performance thus optimising gas utilisation and carbon abatement.

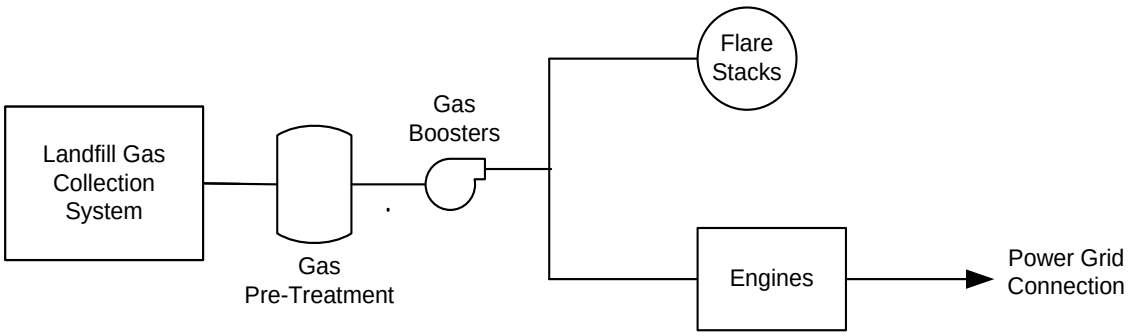

Figure B.1-1 Technical diagram of the project activity

LFG generator sets:
After the LFG has passed through the pre treatment plant the gas is sent to spark ignition power generation units. The electricity produced is distributed to the Thailand Electric Grid. Currently the project activity consists of 8 generator sets manufactured by GE Jenbacher. The specification for the generator sets are shown below:

Parameters	Generator Sets
Quantity	8
Style	4 strokes
Rated rotating speed	1500 r/minute
Rated power	1063 kW
Rated voltage	400 V
Rated frequency	50 Hz

The generator sets used by this project are designed for power generation by utilizing landfill gas.

Flare system:
The surplus gas is destroyed by a flare system. The combination of power generation and flare optimizes the destruction of landfill gas.

The flare installation used by this project meets all of the necessary conditions that are required by "Tool to determine project emissions from flaring gases containing methane" option a) for a default value of 90% for flare efficiency with continuous monitoring of compliance with the flare manufacture specifications. The flare system is equipped with a monitoring system to measure flow, pressure, methane concentration and the temperature in order to comply with the tool.

Below is a summary of the technical specification of the flare:

Parameters	Flare
Type	Enclosed Flare
Quantity	3
Capacity	2,000 Nm^3/h
Flare Temperature (°C)	500-1200
Methane Combustion Efficiency	>98%
Manufacturer	Nanjing Carbon Recycle Biomass Technology Co., Ltd

Specification of the installed monitoring equipment is detailed in the tables included in section D.

The three Flares were installed between October 2009 and January 2010. Landfill gas has been extracted and combusted by flares since February 2010, and the 3 Flares were completely commissioning on 25/06/2010. The physical installation of the first 4*1063kW engines and construction of the grid connection was completed by late March 2010. Following commissioning of the grid connection the project started to export power to the Thai Grid on 8th April 2010. An additional 2*1063kW engines (No. 5 & 6) were installed during April and commissioned during May 2011. An additional 2*1063kW engines (No. 7 & 8) were install during December 2011 and commissioned during January 2012 The dates of commissioning completion for the engines were as follows:

Engine	Commissioning Handover Date	Engine	Commissioning Handover Date
1	18-05-2010	5	20-04-2011
2	17-06-2010	6	20-05-2011
3	18-05-2010	7	27-01-2012
4	18-05-2010	8	27-01-2012

The project activity started to export power on 08-04-2010 at a capacity of 0.8MW, which was subsequently increased to 3MW on 03-06-2010, 4MW on 06-10-2010, 6MW on 26-05-2010 and 6.3MW on 12-07-2011; as each phase of the power generation plant has been granted approval by the Provincial Electricity Authority (PEA) and PEA has approval for the increase from 6.3MW to 8MW export on 18-07-2012.

Meanwhile, excessive landfill gas was also combusted by the flares in conjunction with power generation. At this stage, the combination of power generation and flaring optimizes the destruction of landfill gas. As waste tipping continues and additional LFG is generated, further generator sets will be installed.

Therefore, emission reductions of methane destroyed by both flare and power generation occurred within this monitoring period and emission reductions calculated for both types of LFG destruction are included in this monitoring report.

This is the fifth monitoring report. The monitoring period covered by this monitoring report is: **01-10-2013 – 31-10-2014 (both dates inclusive)**.

The individual engine operational time for this monitoring period is provided in section D.2 – operation of energy plant. Information regarding replacement schedule of monitoring equipment is referred to in Annex E.

Special events which impact on the operation of the project activity such as downtime, major, overhaul, equipment failure, that exceed more than 24 hours during this monitoring period are detailed in Annex F.

No events or situations which may impact the applicability of the methodology occurred during this monitoring period.

B.2. Post registration changes

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

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

B.2.2. Corrections

Not applicable

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

There have been no permanent changes from registered monitoring plan or applied methodology submitted or approved during this monitoring period with this monitoring report.

Previously, there has been permanent changes from registered monitoring plan made to include parameters related to the monitoring of project emissions from temporary fossil fuel consumption as a result of a change to the project design. These changes were approved by the UN secretariat; reference PRC-3462-001, on 8th Feb, 2013.

Changes to the registered GSPDD for removal and addition of ex-ante parameters, and removal of several monitoring parameters were approved by the Gold Standard during issuance of CERs from the previous monitoridng period (01-04-2012 to 30-09-2013). Refer revised GS PDD version 16, dated 13/01/2014.

B.2.4. Changes to project design of registered project activity

There have been no changes to the project design of the project activity submitted or approved during this monitoring period with this monitoring report.

Previously, there has been changes to the project design during the CDM monitoring period 3 (01-11-2011 to 31-03-2012) which consists of the use of a diesel generator when there is no on-site electricity and no availability of electricity from the grid (e.g. during the connection of new engines to the grid). This change was added to the revised project design document (PDD) and approved by the UN secretariat, reference PRC-3462-001, on 8th Feb 2013.

B.2.5. Changes to start date of crediting period

There have been no changes to the start date of crediting period submitted or approved.

B.2.6. Types of changes specific to afforestation or reforestation project activity

Not applicable

SECTION C. Description of monitoring system

In order to guarantee the quality of the data and data collection system, a detailed monitoring manual has been developed and implemented. This detailed monitoring manual (available for verification by the DOE) is based upon requirements set out in the PDD and monitoring plan.

Management structure for the implementation of monitoring plan

A specific CDM department has been established by the project owner and a CDM manager has been appointed to oversee that activities are carried out according to the monitoring plan. The organizational structure for the CDM department is shown below.

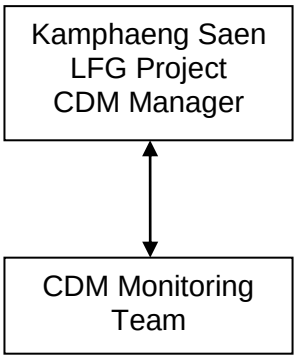

Figure C.1 Organisation Structure of the CDM Team

Responsibility and CDM management: A CDM manager is appointed with responsibility for monitoring all project related activities and organising training. Competency requirements for the position of CDM Manager are defined and applied to ensure that the CDM Manager is able to implement this procedure.

All calculations are checked and signed off by the CDM Manager who is also be responsible for preparing and checking the documents required for verification.

A CDM Monitoring Team, that reports directly to the CDM Manager, has day to day responsibilities for checking instrumentation, record keeping, data handling and data processing, filing, reporting, organizing repair and maintenance of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved PDD. The monitoring staff has received technical training and refresher training as well as safety training to minimize exposure to workplace hazards.

A management level link has been established to ensure effective co-operation between landfill staff and CDM monitoring staff.

All relevant information, notes of meetings, data files, maintenance records, defect reports, hard copy and computerized records of monitoring are kept at a designated location and arranged in an orderly and transparent manner to facilitate auditing as and when required.

Responsibilities, procedures, methods, equipment types and specifications are described in detail in a site-specific CDM monitoring manual.

The parameters monitored and the monitoring procedure applied for determination of the emission reductions is described in detail in section B.7 of the Gold Standard Project Design Document Version 16 dated 13/01/2014. The document is available on website as link:

http://mer.markit.com/br-reg/public/project.jsp?project_id=103000000001559

An overview of the parameters monitored is provided in **Section D**.

The location of measurement devices is presented in figure C.2 below:

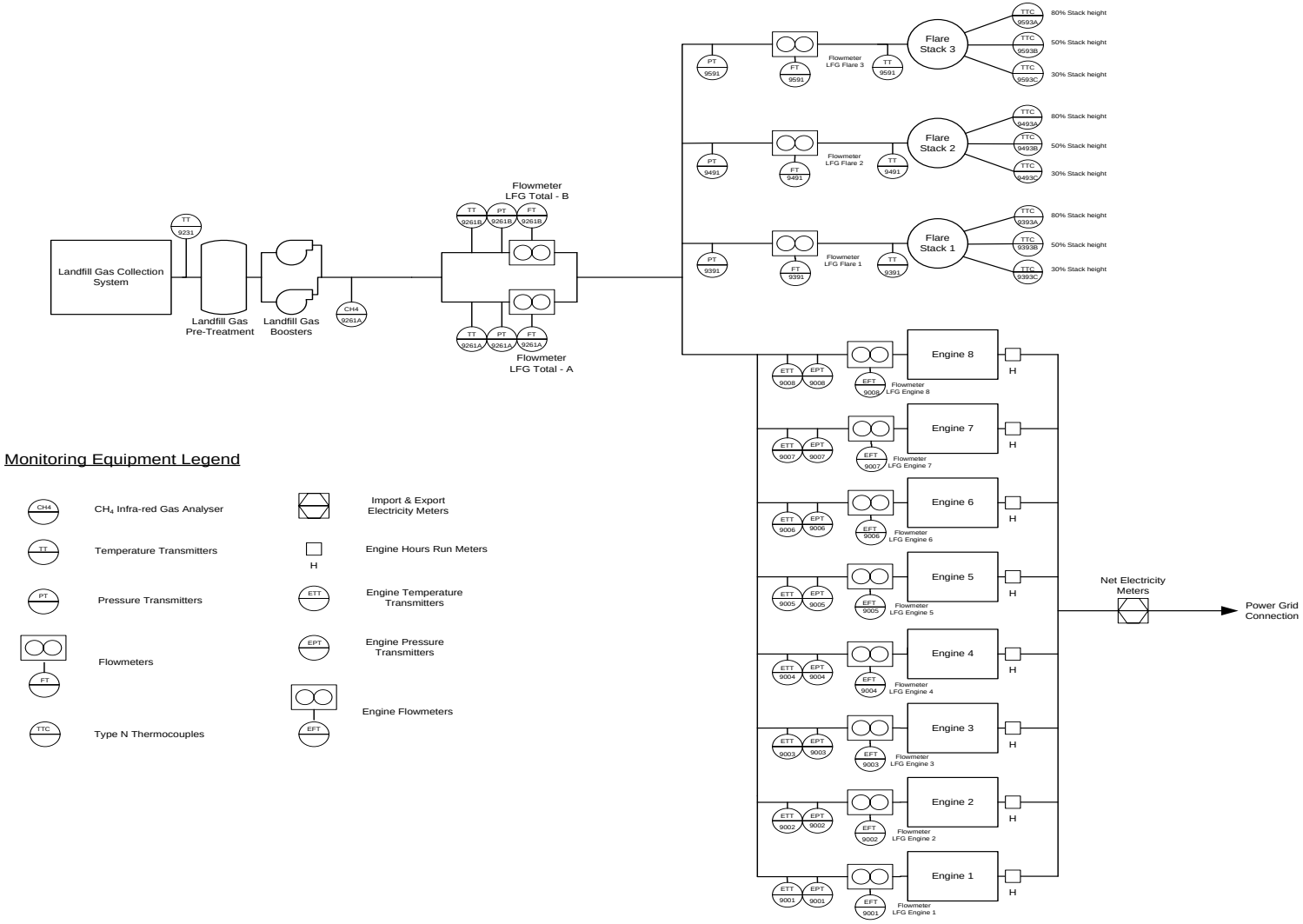

Figure C.2 - Location of the measurement devices[1]

[1] Details of monitoring equipment installation and calibration dates refer to Annex E

Data collection and management

- On-line monitoring

With the exception of the electricity meters which are continual measured and manually recorded on monthly basis, monitoring equipment required to determine GHG emissions and emission reductions are monitored on-line from a central control point which records meter readings at one minute intervals.

- Manual data recording system

A manual data recording system to act as a back-up for the on-line monitoring system is in place. This involves completion of a log sheet that records flow meter readings on daily basis. Spot readings of other values (methane concentration, temperature and pressure) are also recorded periodically and at the times when flow meter readings are taken on daily basis.

- Regulatory requirements related to landfill gas projects

Although the methodology only requires recording at the renewal of the crediting period, the information related to all relevant policies and circumstances are collected and recorded annually. Information will be kept during crediting period and two years after.

- Data archiving

The on-line monitoring system automatically and periodically archives data in a safe manner. Electronic documents are saved for backup, with written documents and back-ups safely kept. Calibration data is saved electronically. All information related to monitoring such as meeting minutes, data documents, maintenance records, accident reports, hard copies as well as computer records, are kept at designated locations to ensure that the examination process is transparent and effective. These data will be stored until 2 years after the end of the crediting period.

Maintenance and calibration of meters

All meters are maintained as specified in the CDM monitoring manual and according to manufacturer specifications. All key meters are subject to a quality control regime that includes regular maintenance and calibration. Calibrations are carried out by the manufacturer or a suitably qualified external company. A record is maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration) and who performs the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

Mass flow of methane supplied to the engines is corroborated by comparison with the sum of the gross engine power outputs, the relationship being a function of engine efficiency which can be considered a constant under the proposed maintenance regime.

Treatment of missing or corrupted data

When data in the on-line system are corrupted or missing the missing data or erroneous data was left as current. Exceptional, the engine flow back calculation will be implemented, if any elements of engine flow calculation missing whilst the generators are operating (as shown, for example, by electricity output). This calculation is undertaken within the algorithm and checked by the QA/QC team. The error will be recorded in the non-compliance log sheet kept on site and the occurrence of the error will be investigated and rectified as soon as possible.

Any error is recorded in the log sheet and the occurrence of the error will be investigated and rectified as soon as possible. If the on-line system is compromised for more than 24 hours, data will be manually recorded. Manually recorded data is backup data for methane destruction amount

and other key parameters. Any deficiencies in methane flow monitoring data are rectified by calculation from power generation data.

Any treatment of missing or corrupt data is detailed and available for verification by DOE.

Non essential data

The on-line monitoring system will also record "non-essential" data. Such data is termed non-essential because it is not directly listed in the CDM Monitoring Methodology, but it will constitute a means of corroborating the on-line system. Non-essential data may include measurements of net and gross output from individual generators, certificated conversion efficiency, waste deposition and any other data considered relevant to the project activity.

Document Control

The CDM Manager has implemented a document control system that ensures that the current versions of necessary documents are available at the point of use.

Audit function and management review

The CDM Manager arranges for an independent internal audit of the management system periodically and at least once per year. The auditor is not be involved in the daily operation of the project and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure and the preparation of the monitoring report. Audit findings and steps taken to address findings are recorded and reviewed in a Management Review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented. The audit reports and annual review meeting notes are available to the verifying DOE.

SECTION D. Data and parameters

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

Data / Parameter:	**GWP_{CH4}**
Unit:	tCO_2e/tCH_4
Description:	Global warming potential of CH_4
Source of data:	IPCC and change from GWP of 21 to 25 according to decision 4/CMP7 and para 66, EB69
Value(s) applied):	25 for second commitment period starting January 1st, 2013
Purpose of data:	For baseline and project emission calculation.
Additional comment:	Shall be updated according to any future COP/MOP decisions

Data / Parameter:	**$EF_{grid,CM,y}$**
Unit:	tCO_2/MWh
Description:	Combined margin emission factor for the grid in year *y*
Source of data:	Calculate the combined margin emission factor, using the procedures in the Tool to calculate the emission factor for an electricity system version 03.0.0
Value(s) applied):	0.5113 tCO_2/MWh
Purpose of data:	For baseline and project emission calculation.
Additional comment:	Only applicable to scenarios A and C (cases C.I and C.III)

Data / Parameter:	**$SPEC_{flare}$**
Unit:	Temperature - °C Flow rate or heat flux – kg/h or m^3/h

Description:	Manufacturer's flare specifications for temperature and flow rate.
Source of data:	• Temperature port fitted to the flares. • V-Cone Flow Meter –with associated Rosemount 3051CD differential pressure transmitter
Value(s) applied):	• Minimum/maximum temperature: 500-1200 °C • Minimum/maximum flow rate: 300-2,000 Nm^3/h
Purpose of data:	For baseline emission and project emission calculation.
Additional comment:	This parameter is applicable as enclosed flares are installed and Option A of the tool "Project emissions from flaring" Version 02.0.0" is selected for this project activity.

Data / Parameter:	**OX**
Unit:	-
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data:	Tool "Emissions from solid waste disposal sites" based on an extensive review of published literature on this subject, including IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied):	0.1
Purpose of data:	For baseline emission calculation.
Additional comment:	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2. This should distinguish from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer

D.2. Data and parameters monitored

Data / Parameter:	**Management of SWDS**
Unit:	N/A
Description:	Management of the SWDS
Measured/ Calculated/ Default:	N/A
Source of data:	Use different sources of data • Original design of landfill • Technical specifications for the management of SWDS • Local or national regulations
Value(s) of monitored parameter:	N/A
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	Original design of the landfill is referred to in order to ensure that any practice to increase methane generation have been occurring prior to the implementation of the project activity. Any change in the management of the landfill after the implementation of the project activity is justified by referring to technical or regulatory specifications.
Purpose of data:	Justification for any changes in the management of the SWDS as there is an impact on baseline emissions
Additional comment:	-

Data / Parameter:	$Op_{j,h}$
Unit:	-
Description:	Operation of the equipment that consumes the LFG in hour *h*. Monitoring of one or more of the following three parameters to ascertain that the plant is operated in hour *h*: • Temperature. Measure the temperature of the exhaust gas in the flare by appropriate temperature measure equipment. • Flame. Flame detection system is used to ensure that the equipment is in operation; • Products generated. Monitor the generation of electricity.
Measured/ Calculated/ Default:	Measured
Source of data:	Use different sources of data. • Temperature port fitted to the flares • Flare flame detector fitted to the flares • Meter
Value(s) of monitored parameter:	Refers to Emission Reductions spreadsheet
Monitoring equipment:	• Type N Thermocouple. See specification details in Annex D. • UV flame detector. See specification details in Annex D. • Measured with individual, software based, run meters on each generator set, readings taken from SCADA system. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measured. Data is aggregated hourly and monthly.
Calculation method (if applicable):	N/A
QA/QC procedures:	Refers to individual parameters
Purpose of data:	If equipment is not working properly as stated above then the baseline and project emission calculations may be affected.
Additional comment:	-

Data / Parameter:	$EG_{PJ,y}$
Unit:	MWh
Description:	Amount of electricity generated using LFG by the project activity in year y
Measured/ Calculated/ Default:	Measured
Source of data:	Electricity meter
Value(s) of monitored parameter:	Refers to table 2 of section E4.Emission reductions calculation and cell F27 to F39 of 201310-201410_Report tab of Emission Reductions spreadsheet.
Monitoring equipment:	• Electricity Meter • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuously measured. Data is aggregated monthly and yearly.
Calculation method (if applicable):	N/A

QA/QC procedures:	The electricity meters are maintained and calibrated according to manufacturer's instructions or the relevant regulations. Data will be archived for two years after the crediting period or two years after the last issuance of CERs. The data can be corroborated against financial data from the export of power to the grid.
Purpose of data:	For baseline emission calculation.
Additional comment:	This parameter is required for calculating baseline emissions associated with electricity generation ($BE_{EC,y}$) using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

Data / Parameter:	**$EG_{EC,y}$** (The same parameter as **$EC_{PJ,y}$** different nomenclature for ACM0001version 13.0.0 and "Tool to calculate baseline, project and/or leakage emission from electricity consumption" version 01)
Unit:	MWh
Description:	Amount of electricity consumed by the project activity in year y
Measured/ Calculated/ Default:	Measured
Source of data:	Electricity meter
Value(s) of monitored parameter:	Refers to table 2 of section of E4.Emission reductions calculation and cell C142 to C154 of 201310-201410_Report tab of Emission Reductions spreadsheet.
Monitoring equipment:	• Electricity Meter • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuously measured. Data is aggregated monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	The electricity meters are maintained and calibrated according to manufacturer's instructions or the relevant regulations. Data will be archived for two years after the crediting period or two years after the last issuance of CERs. The data can be corroborated against financial data from the import of power from the grid
Purpose of data:	For project emission calculation
Additional comment:	This parameter is required for calculating project emissions from electricity consumption due to an alternative waste treatment process ($PE_{EC,y}$) using the 'Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

Data / Parameter:	**$V_{t,db}$**
Unit:	m^3dry gas/h
Description:	Volumetric flow of the gaseous stream in time interval *t* on a dry basis
Measured/ Calculated/ Default:	Measured
Source of data:	Flow meter reading measured total gas collected, gas fed to generator sets and gas fed to flares.
Value(s) of monitored parameter:	Refers to E4.Emission reductions calculation / table

Monitoring equipment:	• V-Cone Flow Meter – with associated Rosemount 3051CD differential pressure transmitter. • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measuring/reading every minute. Data is aggregated monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	Data is backed up and archived, where it is stored for two years longer than the crediting period or two years after the last issuance of CERs. For internal cross checking purposes the consistency of flow measurements will be checked by examining the hourly flow balance. Landfill Gas (LFG) fed to generators and flares was compared with Overall LFG in every minute. The conservative value of is used for ER calculation. $(LFG_{flare,h} + LFG_{electricity,h}) = LFG_{total,h}$ Flow meter is calibrated according to the manufacturer's specifications. Calibrations are carried out by the manufacturer or a suitably qualified external company. Calibration and maintenance records are retained. On site staff has received training in CDM monitoring and the maintenance requirements of the flow meters.
Purpose of data:	For baseline emission calculation
Additional comment:	In the case where Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" was applied

Data / Parameter:	$\mathbf{V_{i,t,db}}$
Unit:	m3 gas i/m3 dry gas
Description:	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Measured/ Calculated/ Default:	Measured
Source of data:	Gas quality analyser reading
Value(s) of monitored parameter:	Refers to E4.Emission reductions calculation / table
Monitoring equipment:	• Infra-Red Gas Monitor. • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measuring/reading every minute Data is aggregated monthly and yearly
Calculation method (if applicable):	N/A
QA/QC procedures:	Routine checks are performed by the CDM Monitoring Team to ensure proper functioning of the equipment. Any faults are reported to the CDM Manager for action. Monthly zero checks using atmospheric air or a certified nitrogen reference gas. Monthly site gas span undertaken using certified calibration gas. Gas analyser maintained and calibrated as per manufacturers recommendations. Data is backed up and archived where it is stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.
Purpose of data:	For baseline emission calculation
Additional comment:	Demonstrate that the gaseous stream is dry to use Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". This is done by: b) Demonstrate that the temperature of the gas stream (T_t) is less than 60°C (333.15 K) at the flow measurement point. When Option A was applied, this parameter is monitored

Data / Parameter:	T_t
Unit:	K/°C
Description:	Temperature of the gaseous stream in time interval *t*
Measured/ Calculated/ Default:	Measured
Source of data:	Temperature probe in LFG pipe work among the gas treatment package, the generator sets and the flares
Value(s) of monitored parameter:	Refers to Emission Reduction spreadsheet.
Monitoring equipment:	• Temperature Transmitter. • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measuring/reading every minute
Calculation method (if applicable):	N/A
QA/QC procedures:	Routine checks are performed by CDM Monitoring Team to ensure proper functioning of the equipment. Any faults are reported to the CDM Manager for action. Temperature probe maintained and calibrated as per manufacturers recommendations. Data is backed up and archived where it is stored for the longer of two years longer than the crediting period or two years after the last issuance of CER's.
Purpose of data:	For baseline and project emission calculation
Additional comment:	Provided all parameters are converted to normal conditions during the monitoring process. Therefore it is metered only when performing such measurements (with same frequency). However, the applicability condition related to the gaseous stream flow temperature being below 60°C is adopted. Therefore, this parameter is monitored continuously to assure the applicability condition is met.

Data / Parameter:	P_t
Unit:	Pa
Description:	Pressure of the gaseous stream in time interval *t*
Measured/ Calculated/ Default:	Measured
Source of data:	Pressure transmitter mounted in LFG pipe work among the gas treatment package, the generator sets and the flares.
Value(s) of monitored parameter:	Refers to Emission Reduction spreadsheet.
Monitoring equipment:	• Absolute Pressure Transmitter. • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measuring/reading every minute. Data is aggregated monthly and yearly.
Calculation method (if applicable):	N/A
QA/QC procedures:	Routine checks are performed by CDM Monitoring Team to ensure proper functioning of the equipment. Any faults are reported to the CDM Manager for action. Pressure Transmitter maintained and calibrated as per manufacturers recommendations. Data is backed up and archived where it will be stored for the longer of two years longer than the crediting period or two years after the last issuance of CER's.
Purpose of data:	For baseline emission calculation

Additional comment:	Provided all parameters are converted to normal conditions during the monitoring process. Therefore it is metered only when performing such measurements (with same frequency).

Data / Parameter:	**TEG_m**
Unit:	°C
Description:	Temperature in the exhaust gas of the enclosed flare in minute *m*
Measured/ Calculated/ Default:	Measured
Source of data:	Temperature port fitted to the flares.
Value(s) of monitored parameter:	Refers to Emission Reduction spreadsheet.
Monitoring equipment:	• Type N Thermocouple. • See specification details in Annex D. • See installation date, calibration dates and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Continuous measuring/reading every minute
Calculation method (if applicable):	N/A
QA/QC procedures:	Routine checks are performed by Site Engineers to ensure proper functioning of the equipment. Any faults are reported to the CDM Manager for action. Thermocouple maintained and calibrated as per manufacturer's recommendations. Data is backed up and archived where it will be stored for two years after the crediting period or two years after the last issuance of CER's.
Purpose of data:	For baseline and project emission calculation.
Additional comment:	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. These events are noted in the site records along with any corrective action that was implemented to correct the issue. Monitoring of this parameter is applicable as enclosed flares are installed. Measurements are required to ensure that operating temperature during this monitoring period are met the manufacturer's flare specifications.

Data / Parameter:	**$Flame_m$**
Unit:	Flame on or Flame off
Description:	Flame detection of flare in the minute *m*
Measured/ Calculated/ Default:	Measured
Source of data:	Project participants
Value(s) of monitored parameter:	N/A
Monitoring equipment:	• Ultra Violet flame detector. • See specification in Annex D. • See installation date and equipment validity periods in Annex E.
Measuring/ Reading/ Recording frequency:	Once per minute. Detection of flame recorded as a minute that the flame was on, otherwise recorded as a minute that the flame was off.
Calculation method (if applicable):	N/A
QA/QC procedures:	Equipment is maintained in accordance with manufacturer's recommended that no calibration required for this instrument since the measurement is to detect flame on or off.
Purpose of data:	For baseline emission and project emission calculation

Additional comment:	This parameter used for determine that the flare efficiency for the minute *m* ($\eta_{flare,m}$) is 90% once this parameter is detected, otherwise is 0%.

Data / Parameter:	**Maintenance $_y$**
Unit:	Calendar dates
Description:	Maintenance events completed in year *y*
Measured/ Calculated/ Default:	Measured
Source of data:	Project participants
Value(s) of monitored parameter:	-
Monitoring equipment:	Records of maintenance logs of generator sets, pretreatment and Flares
Measuring/ Reading/ Recording frequency:	Annual frequency
Calculation method (if applicable):	N/A
QA/QC procedures:	Records are kept and archived where it is stored for the longer of two years longer than the crediting period or two years after the last issuance of CERs.
Purpose of data:	For baseline emission and project emission calculation
Additional comment:	These dates are required to compare with maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{flare}$)

Data / Parameter:	**$FC_{i,j,y}$**
Unit:	Mass or volume unit per year (e.g. ton/yr or m^3/yr)
Description:	Quantity of fuel type i combusted in process j during the year y. In an emergency situation, diesel oil may be used in the project activity as fuel type i.
Measured/ Calculated/ Default:	Measured
Source of data:	Onsite measurements by project participants
Value(s) of monitored parameter:	Refers to Emission Reductions spreadsheet
Monitoring equipment:	Rulers
Measuring/ Reading/ Recording frequency:	Fuel is supplied from small daily tanks and rulers were used to determine mass or volume of the fuel consumed. The fuel consumed was recorded in record sheet on daily basis.
Calculation method (if applicable):	N/A
QA/QC procedures:	The consistency of metered fuel consumption quantities were cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices identified specifically for the CDM project, the metered fuel consumption quantities were cross-checked with available purchase invoices from the financial records.
Purpose of data:	For project emission calculation
Additional comment:	N/A

Data / Parameter:	**$NCV_{i,y}$**
Unit:	GJ/litre
Description:	Weighted average net calorific value of fuel type i in year y. In an emergency situation, diesel oil may be used in the project activity as fuel type i.

Measured/ Calculated/ Default:	Default value
Source of data:	IPCC default values at the upper limit of the uncertainly at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG inventories
Value(s) of monitored parameter:	0.03642 GJ/litre
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Any future revision of the IPCC Guidelines should be taken into account.
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	For project emission calculation
Additional comment:	Applicable where Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) is used

Data / Parameter:	**$EF_{CO2,i,y}$**
Unit:	tCO_2/GJ
Description:	Weighted average CO_2 emission factor of fuel type i in year
Measured/ Calculated/ Default:	Default value
Source of data:	IPCC default values at the upper limit of the uncertainly at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG inventories
Value(s) of monitored parameter:	0.07480 tCO_2/GJ
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Any future revision of the IPCC Guidelines should be taken into account
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	For project emission calculation
Additional comment:	-

Data / Parameter:	**$TDL_{i,y}$ and $TDL_{k,y}$**
Unit:	Dimensionless
Description:	Average technical transmission and distribution losses for providing electricity to source *j* or *k* in year *y*
Measured/ Calculated/ Default:	Calculated
Source of data:	Annual Report Thailand Energy Statistics 2013 (Preliminary) by DEDE Department Ministry of Energy, Thailand. Most recent, accurate and reliable published data available within the host country is applied.
Value(s) of monitored parameter:	9.16 %
Monitoring equipment:	N/A
Measuring/ Reading/ Recording frequency:	Annually

Calculation method (if applicable):	<table><tr><td>Year</td><td>2013</td></tr><tr><td>Electric Supply Generation</td><td>169,593</td></tr><tr><td>Electric Supply Net Import</td><td>11,290</td></tr><tr><td>Station Service Consumed</td><td>6,220</td></tr><tr><td>Line Losses</td><td>10,340</td></tr><tr><td>Net Electric Consumed</td><td>164,323</td></tr><tr><td>Distribution loss</td><td>9.16%</td></tr></table> Total distribution loss = (Station Service Consumed + Line Losses) / (Electric Supply Generation + Electric Supply Net Import)
QA/QC procedures:	N/A
Purpose of data:	For baseline emission and project emission calculation
Additional comment:	N/A

D.3. Implementation of sampling plan

Not applicable

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

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

The formula used for determination of the baseline emissions are described in section B.6 of the registered GS PDD for the project activity.

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad (1)$$

Where:

BE_y = Baseline emission in year y (tCO_2e)
$BE_{CH4,y}$ = Baseline emission of methane from the SWDS in year *y* (tCO_2e/yr)
$BE_{EC,y}$ = Baseline emissions associated with electricity generation in year *y* (tCO_2e/yr)
$BE_{HG,y}$ = Baseline emissions associated with heat generation in year *y* (tCO_2e/yr)
$BE_{NG,y}$ = Baseline emissions associated with natural gas use in year *y* (tCO_2e/yr)

In this project there will be no heat generation or natural gas use from LFG therefore:

$$BE_{HG,y} \text{ and } BE_{NG,y} = 0 \quad (2)$$

$$BE_{CH4,y} = (1-OX_{top\_layer}) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} \quad (3)$$

Where:

$BE_{CH4,y}$ = Baseline emissions of LFG from the SWDS in year (tCO_2e/yr)
OX_{top_layer} = Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline (dimensionless)
$F_{CH4,PJ,y}$ = Amount of methane in the LFG that would be flared and/or used in the project activity in year ($tCH_{4/yr}$)
$F_{CH4,BL,y}$ = Amount of methane in the LFG that would be flared in the baseline in year (tCH_4/yr)
GWP_{CH4} = Global warming potential of CH_4 (tCO_2e/tCH_4). The value for the second commitment period it is 25

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad (4)$$

Where:

$F_{CH4,PJ,y}$ = Amount of methane in the LFG which is flared and/or used in the project activity in year (tCH_4/yr)

$F_{CH4,flared,y}$ = Amount of methane in the LFG which is destroyed by flaring in year (tCH_4/yr)

$F_{CH4,EL,y}$ = Amount of methane in the LFG which is used for electricity generation in year ($tCH_{4/yr}$)

$F_{CH4,HG,y}$ = Amount of methane in the LFG which is used for heat generation in year (tCH_4/yr)

$F_{CH4,NG,y}$ = Amount of methane in the LFG which is sent to the natural gas distribution network in year (tCH_4/yr)

As the project activity does not include heat generation from LFG or sent to the natural gas distribution network, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ = 0

$F_{CH4,EL,y}$ is *determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous steam*" Version 02.0.0 and the operational hours of the power plant, so that no emission reductions are claimed for methane destruction during non-working hours. This is taken into account by monitoring the hours that the equipment utilizing the LFG is operating in year ($Op_{j,h,y}$).

The following requirements have been applied:

- The gaseous stream tool has been applied to the LFG delivery pipeline to each item of electricity. $F_{CH4,EL,y}$ was then calculated as the sum of mass flows of electricity generation equipment *j*;
- CH_4 is the greenhouse gas for which mass flow have been determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the tool);
- The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;
- The mass flow calculated for hour *h* was 0 if the equipment was not working in hour *h* ($Op_{j,h}$ = not working), the hourly values were then summed to a yearly unit basis

Methane content measured on a wet basis and if the temperature of the gas stream (T_t) was less than 60°C (333.15 K) at the flow measurement point, gaseous stream then demonstrated as dry gas. It then applied for Option A, otherwise applied for Option C

In case, Option A applied, the mass flow of methane then determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (5)$$

With

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (6)$$

Where:

$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)

$V_{i,t,db}$ = Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m^3 gas *i*/m^3 dry gas)

$\rho_{i,t}$ = Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3gas *i*)

P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa)

MM_i = Molecular mass of greenhouse gas *i* (kg/kmol)

R_u = Universal ideal gases constant (Pa.m^3/kmol.k)
T_t = Temperature of the gaseous stream in team interval *t* (K)

If Option C applied, the mass flow of methane determined as follows:

$$F_{i,t} = V_{t,wb,n} * v_{i,t,wb} * \rho_{i,n} \quad (7)$$

With

$$\rho_{i,n} = \frac{P_n * MM_i}{R_u * T_n} \quad (8)$$

Where:
$F_{i,t}$ = Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,wb,\ n}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions (m³ wet gas/h)
$v_{i,t,wb}$ = Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a wet basis (m³ gas *i*/m³ wet gas)
$\rho_{i,n}$ = Density of greenhouse gas *i* in the gaseous stream at normal conditions (kg gas *i*/m³ wet gas *i*)
P_n = Absolute pressure at normal conditions (Pa)
T_n = Temperature at normal conditions (K)
MM_i = Molecular mass of greenhouse gas *i* (kg/kmol)
R_u = Universal ideal gases constant (Pa.m3/kmol.K)

The following equation is used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} * [(T_n / T_t) * (P_t / P_n)] \quad (9)$$

Where:
$V_{t,wb,n}$ = Volumetric flow of the gaseous stream in a time interval *t* on a wet basis at normal conditions (m^3 wet gas/h)
$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (*m*^{3} wet gas/h)
P_t = Pressure of the gaseous stream in time interval *t* (K)
T_t = Temperature of the gaseous stream in time interval *t*
P_n = Absolute pressure at normal conditions (Pa)
T_n = Temperature at normal conditions (K)

$$F_{CH4,\ flared,\ y} = F_{CH4,sent\_flare,y} - PE_{flare,y}/GWP_{CH4} \quad (10)$$

Where:

$F_{CH4,\ flared,\ y}$ = Amount of methane in the LFG which is destroyed by flaring in year (tCH_4/yr)
$F_{CH4,sent\_flare,y}$ = Amount of methane in the LFG which is sent to the flare in year (tCH_4/yr)
$PE_{flare,y}$ = Project emissions from flaring of the residual gas stream in year (tCO_2e/yr)
GWP_{CH4} = Global warming potential of CH_4 (t CO_2e/t CH_4)

$F_{CH4,sent\_flare,y}$ was determined directly using the requirements stated earlier whereby the gaseous stream tool is applied to the LFG delivery pipeline to each flare. $F_{CH4,sent,flare,\ y}$ was then calculated as the sum of mass flows to each flare.

$PE_{flare,y}$ was calculated as per the methodological tool "Project emission from flaring" Version 02.0.0. As there are more than one flare then $PE_{flare,y}$ was the sum of the emissions for each flare determined separately.

Project emissions from flaring were calculated as the sum of emissions for each minute *m* in the year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} \times \sum_{m=1}^{525600} F_{CH4,RG,m} \times \left(1 - \eta_{flare,m}\right) \times 10^{-3} \quad \textbf{(11)}$$

Where:

$PE_{flare,y}$	= Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}	= Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	= Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	= Flare efficiency in minute *m*

$F_{CH4,RG,m}$ was determined on a dry basis by using the "Tool to determine the mass flow of a greenhouse gas in a gaseous steam" Version 02.0.0 on in the minute *m*.

In this project $\mathbf{F_{CH4,BL,y} = 0}$ as there was no methane destructed due to regulatory or contractual requirements in the absence of this project.

The baseline emissions associated with electricity generation (electricity exported to the grid) in year *y* ($BE_{EC,y}$) was calculated using the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 01. When the tool applied $\mathbf{EC_{BL,k,y} = EG_{PJ,y}}$

Following Scenario A (Electricity consumption from the grid) in the tool, $BE_{EC,y}$ is calculated as follows.

$$BE_{EC,y} = \sum_k EC_{BL,k,y} \times EF_{EL,k,y} \times \left(1 + TDL_{k,y}\right) \quad \textbf{(12)}$$

Where:

k	= Sources of electricity consumption in the baseline
$EG_{PJ,y}$	= Quantity of electricity that would be consumed by the baseline electricity consumption source *k* in year *y* (tCO_2/MWh)
$TDL_{k,y}$	= Average technical transmission and distribution losses for providing electricity to source *k* in year

The baselines emissions are calculated in the attached ER calculation excel spreadsheets, and summary of calculation results is provided in Tables 1 to 4 of section E.4 below.

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

$$\mathbf{PE_y = PE_{EC,y} + PE_{FC,j.y}} \quad \textbf{(13)}$$

Where:

PE_y	= Project emissions in year *y* (tCO_2/yr)
$PE_{EC,y}$	= Emission from consumption of electricity due to the project activity in year y (tCO_2/yr)
$PE_{FC,j.y}$	= Emission from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y (tCO_2/yr)

When fossil fuel was consumed by the project activity, CO_2 emission from fossil fuel combustion in process were calculated based on the quantity of fuels combusted and the CO_2 emission

coefficient of those fuels, $PE_{FC,j.y}$ is determined using the procedure described in Methodological " Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" Version 02, follows.

$$PE_{FC,j,y} = \Sigma_i FC_{i,j,y} \times COEF_{i,y} \quad \textbf{(14)}$$

Where:

$PE_{FC,j,y}$	= Are the CO_2 emissions from fossil fuel combustion in process *j* during the year *y* (tCO_2/yr);
$FC_{i,j,y}$	= Is the quantity of fuel type i combusted in process *j* during the year *y* (mass or volume unit/yr);
$COEF_{i,y}$	= Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or Volume unit)
i	= Are the fuel types combusted in process *j* during the year *y*

The CO_2 emission coefficient $COEF_{i,y}$ were calculated using Option B due to the availability of data on the fossil fuel type i, as follows:

Option B: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type *i*, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y} \quad \textbf{(15)}$$

Where:

$COEF_{i,y}$	= Is the CO_2 emission coefficient of fuel type *i* in year *y* (tCO_2/mass or Volume unit)
$NCV_{i,y}$	= Is the weighted average net calorific value of the fuel type *i* in year *y* (GJ/mass or volume unit)
$EF_{CO2,i,y}$	= Is the weighted average CO_2 emission factor of fuel type *i* in year *y* (tCO_2/GJ)
i	= Are the fuel types combusted in process *j* during the year *y*

Project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) is determined using the "Tool to calculate baseline, project and/or leakage emissions from energy consumption" Version 01

$$PE_{EC,y} = EC_{PJ,y} \times EF_{EL,j,y} \times \left(1 + TDL_{j,y}\right) \quad \textbf{(16)}$$

Where

$EC_{PJ,y}$	= Electricity imported from the grid and used in the project in year *y* (MWh/yr)
$EF_{EL,j,y}$	= CO_2 emission factor of the Thailand Grid in year *y* (tCO_2e/MWh)
$TDLj,_y$	= Average technical transmission and distribution losses for providing electricity to the project in year *y* (fraction)

The projects emissions are calculated in the attached ER calculation excel spreadsheets, and summary of calculation results is given in Table 5 to 7 of section E.4.

E.3. Calculation of leakage

No leakage effects need to be accounted under ACM0001 version 13

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

Emission reductions are calculated using ACM 0001 version 13, as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(17)}$$

Where:

ER_y = Emission reductions in year y (tCO_2e/yr)
BE_y = Baseline emissions in year y (tCO_2e/yr)
PE_y = Project emissions in year y (tCO_2e/yr)

The emission reductions are calculated in the attached ER calculation excel spreadsheets, and a summary of the calculation results is provided in Table 9.

See registered GS PDD for detailed information as link:

http://mer.markit.com/br-reg/public/project.jsp?project_id=103000000001559

Calculation sheets are provided below.

Notes on ER Calculations:

1. The overall gas fed to power plant and gas fed to generator sets and flares are measured using V-Cone pressure differential flow meters at each location as detailed in section D.2 above. At each V-cone flow measuring location an independent temperature transmitter and pressure transmitter is also installed to measure the LFG at this location. These working conditions are then used to convert the flow of LFG to NTP. The methane mass flow is then determined as stated in section E.1.
2. As enclosed flares are used in the project activity, flare efficiency determination is referred to Option A: Apply for a default value for flare efficiency is selected from the tool “Project emissions from flaring” Version 02.0.0. See annex B for detailed information.

The following table shows monthly total LFG collected by project and amount of LFG fed to each individual flare stack and each engine.

Table 1 Monthly net methane destruction attribute to the project activity.

Date		Operation of the equipment that consumes the LFG in hour	Amount of total LFG captured measured in Nm3	Amount of LFG fed to flare measured in Nm3	Amount of LFG fed to the power generators measured in Nm3	Average value of concentration of methane in LFG m3CH4/m3LFG	Amount of methane gas fed to the flare used for MD calculation in Nm3	Amount of methane gas fed to the power generators used for MD calculation in Nm3
		$Op_{j,h,y}$	$LFG_{Total,\ y}$ ($V_{t,db}$)	$LFG_{Flare,\ y}$ ($V_{t,db}$)	$LFG_{Electricity,\ y}$ ($V_{t,db}$)	$v_{i,t,db}$	$V_{CH4,Flare}$	$V_{CH4,Engine}$
01/10/2013	31/10/2013	744	3,188,137	49,140	2,950,785	60	29,490	1,757,476
01/11/2013	30/11/2013	711	3,077,476	55,858	2,841,969	59	32,861	1,683,992
01/12/2013	31/12/2013	736	3,127,340	128,591	2,842,108	60	78,049	1,721,839
01/01/2014	31/01/2014	744	3,133,724	93,978	2,892,884	60	57,018	1,746,460
01/02/2014	28/02/2014	672	2,925,247	41,093	2,710,961	59	24,873	1,589,110
01/03/2014	31/03/2014	743	3,410,643	12,461	3,164,694	56	7,208	1,762,102
01/04/2014	30/04/2014	719	3,161,831	21,820	2,925,028	56	12,779	1,640,786
01/05/2014	31/05/2014	692	2,915,563	7,401	2,731,842	55	4,476	1,595,754
01/06/2014	30/06/2014	685	2,964,697	15,937	2,773,516	58	10,123	1,696,725
01/07/2014	31/07/2014	744	3,254,242	3,159	3,050,358	59	1,906	1,789,668
01/08/2014	31/08/2014	729	3,025,616	0	2,885,161	59	0	1,745,095
01/09/2014	30/09/2014	720	2,941,103	59,339	2,760,102	61	36,629	1,695,914
01/10/2014	31/10/2014	744	3,144,500	87,598	2,897,351	60	52,489	1,730,408
Remark:	* The LFG fed to the flare and the power generators was compared with the LFG_{total} in every minute. The lowest values of quantity of methane Gas fed to the flare and power generators are presented in this table and are used for calculation of $F_{CH4,PJ,y}$ at next step data process, according to QA/QC.							

Table 2 Baseline emission associated with electricity generation

Date		Amount of methane gas fed to the power generators measured in Nm3	Average methane density in LFG fed to the power generators (kg-CH4/m3-CH4)	Amount of methane in the LFG used for electricity generation (t-CH_4)	Amount of electricity generated using LFG (MWh)	CO_2 emission factor for electricity generation (tCO_2e/MWh)	Average technical transmission and distribution losses for providing electricity to Thai Grid	Baseline emission associated with electricity generation (tCO_2e)
		$V_{CH4,Engine}$	$\rho_{i,t}$	$F_{CH4,EL,y}$	$EG_{PJ,y}$	$EF_{EL,k,y}$	$TDL_{k,y}$	$BE_{EC,y}$
01/10/2013	31/10/2013	1,757,476	0.7284	1,280	5,700.05	0.5113	9.16%	3,181
01/11/2013	30/11/2013	1,683,992	0.7114	1,215	5,381.26	0.5113	9.16%	3,003
01/12/2013	31/12/2013	1,721,839	0.7333	1,277	5,507.53	0.5113	9.16%	3,074
01/01/2014	31/01/2014	1,746,460	0.7390	1,291	5,635.27	0.5113	9.16%	3,145
01/02/2014	28/02/2014	1,589,110	0.7280	1,156	5,056.27	0.5113	9.16%	2,822
01/03/2014	31/03/2014	1,762,102	0.7112	1,252	5,504.28	0.5113	9.16%	3,072
01/04/2014	30/04/2014	1,640,786	0.6819	1,119	5,174.04	0.5113	9.16%	2,888
01/05/2014	31/05/2014	1,595,754	0.6460	1,102	5,275.32	0.5113	9.16%	2,944
01/06/2014	30/06/2014	1,696,725	0.6779	1,206	5,131.20	0.5113	9.16%	2,864
01/07/2014	31/07/2014	1,789,668	0.7027	1,258	5,471.76	0.5113	9.16%	3,054
01/08/2014	31/08/2014	1,745,095	0.7032	1,245	5,422.79	0.5113	9.16%	3,027
01/09/2014	30/09/2014	1,695,914	0.7265	1,232	5,349.96	0.5113	9.16%	2,986
01/10/2014	31/10/2014	1,730,408	0.7308	1,265	5,666.40	0.5113	9.16%	3,163
Remark	** Data in this table are aggregated from hourly results; calculation formulas are used in hourly level. The average value during the month of methane density are presented in this and are used for calculation of $F_{CH4,EL,y}$							

Table 3-1 Methane destroyed by flaring (Flare 1)

Date		Amount of methane gas fed to flare measured in Nm3	Average methane density in LFG fed to flare (kg-CH4/m3-CH4)	Amount of methane in the LFG sent to the flare (tCH4)	Global warming potential of methane (tCO_2e/tCH_4)	Project emissions from flaring of the residual gas (tCO_2e)	Amount of methane in the LFG destroyed by flaring (tCH_4)
		$V_{CH4,flare1}$	$\rho_{i,t}$	$F_{CH4,sent\_flare,y}$	GWP_{CH4}	$PE_{flare,y}$	$F_{CH4,flared,y}$
01/10/2013	31/10/2013	12,453	0.7510	8	25	22	7
01/11/2013	30/11/2013	26,905	0.7317	17	25	45	16
01/12/2013	31/12/2013	73,010	0.7219	48	25	123	43
01/01/2014	31/01/2014	53,282	0.7423	35	25	91	32
01/02/2014	28/02/2014	24,873	0.7381	16	25	41	14
01/03/2014	31/03/2014	7,019	0.7611	5	25	12	4
01/04/2014	30/04/2014	12,779	0.7484	8	25	21	7
01/05/2014	31/05/2014	4,476	0.6943	3	25	8	3
01/06/2014	30/06/2014	9,575	0.6994	6	25	16	5
01/07/2014	31/07/2014	0	0.7438	0	25	0	0
01/08/2014	31/08/2014	0	0.7317	0	25	0	0
01/09/2014	30/09/2014	36,145	0.7275	23	25	59	21
01/10/2014	31/10/2014	48,444	0.7255	31	25	81	28
Remark	*** Methane density and Project emissions from flaring in this table are aggregated from minutely results; calculation formulas are used in minutely level. Amount of methane in the LFG destroyed by flaring are aggregated and calculated from hourly results; calculation formulas are used in hourly results.						

Table 3-2 Methane destroyed by flaring (Flare 2)

Date		Amount of methane gas fed to flare measured in Nm3	Average methane density in LFG fed to flare (kg-CH4/m3-CH4)	Amount of methane in the LFG sent to the flare (tCH4)	Global warming potential of methane (tCO_2e/tCH_4)	Project emissions from flaring of the residual gas (tCO_2e)	Amount of methane in the LFG destroyed by flaring (tCH_4)
		$V_{CH4,flare2}$	$\rho_{i,t}$	$F_{CH4,sent\_flare,y}$	GWP_{CH4}	$PE_{flare,y}$	$F_{CH4,flared,y}$
01/10/2013	31/10/2013	17,037	0.7442	11	25	137	6
01/11/2013	30/11/2013	5,956	0.7447	4	25	76	1
01/12/2013	31/12/2013	157	0.7583	0	25	0	0
01/01/2014	31/01/2014	0	0.7655	0	25	0	0
01/02/2014	28/02/2014	0	0.7553	0	25	0	0
01/03/2014	31/03/2014	189	0.7655	0	25	3	0
01/04/2014	30/04/2014	0	0.7552	0	25	0	0
01/05/2014	31/05/2014	0	0.6973	0	25	0	0
01/06/2014	30/06/2014	548	0.7065	0	25	3	0
01/07/2014	31/07/2014	1,906	0.7446	1	25	26	0
01/08/2014	31/08/2014	0	0.7336	0	25	0	0
01/09/2014	30/09/2014	484	0.7450	0	25	1	0
01/10/2014	31/10/2014	4,045	0.7457	3	25	8	2
Remark	*** Methane density and Project emissions from flaring in this table are aggregated from minutely results; calculation formulas are used in minutely level. Amount of methane in the LFG destroyed by flaring are aggregated and calculated from hourly results; calculation formulas are used in hourly results.						

Table 3-3 Methane destroyed by flaring (Flare 3)

Date		Amount of methane gas fed to flare measured in Nm3	Average methane density in LFG fed to flare (kg-CH4/m3-CH4)	Amount of methane in the LFG sent to the flare (tCH4)	Global warming potential of methane (tCO_2e/tCH_4)	Project emissions from flaring of the residual gas (tCO_2e)	Amount of methane in the LFG destroyed by flaring (tCH_4)
		$V_{CH4,flare3}$	$\rho_{i,t}$	$F_{CH4,sent\_flare,y}$	GWP_{CH4}	$PE_{flare,y}$	$F_{CH4,flared,y}$
01/10/2013	31/10/2013	0	0.7568	0	25	0	0
01/11/2013	30/11/2013	0	0.7493	0	25	0	0
01/12/2013	31/12/2013	4,882	0.7578	4	25	96	0
01/01/2014	31/01/2014	3,736	0.7649	3	25	74	0
01/02/2014	28/02/2014	0	0.7548	0	25	0	0
01/03/2014	31/03/2014	0	0.7649	0	25	0	0
01/04/2014	30/04/2014	0	0.7544	0	25	0	0
01/05/2014	31/05/2014	0	0.6964	0	25	0	0
01/06/2014	30/06/2014	0	0.7062	0	25	0	0
01/07/2014	31/07/2014	0	0.7464	0	25	0	0
01/08/2014	31/08/2014	0	0.7349	0	25	0	0
01/09/2014	30/09/2014	0	0.7464	0	25	0	0
01/10/2014	31/10/2014	0	0.7495	0	25	0	0
Remark	*** Methane density and Project emissions from flaring in this table are aggregated from minutely results; calculation formulas are used in minutely level. Amount of methane in the LFG destroyed by flaring are aggregated and calculated from hourly results; calculation formulas are used in hourly results.						

The following table shows monthly net methane destruction attributed to the project activity and total emission reductions completed associated with project activity in this monitoring period.

Table 4 Baseline emission of LFG from the SWDS

Date		Amount of methane in the LFG flared and used in the project activity ($t\text{-}CH_4$)	Amount of methane in the LFG flared in the baseline	Global warming potential of methane (tCO_2e/tCH_4)	Oxidation factor (reflecting the amount of methane from landfill that is oxidised in the soil or other material covering the waste)	Baseline emission of LFG from the SWDS
		$F_{CH4,PJ,y}$	$F_{CH4,BL,y}$	GWP_{CH4}	OX	$BE_{CH4,y}$
01/10/2013	31/10/2013	1,293	0	25	0.1	29,094
01/11/2013	30/11/2013	1,231	0	25	0.1	27,702
01/12/2013	31/12/2013	1,320	0	25	0.1	29,693
01/01/2014	31/01/2014	1,322	0	25	0.1	29,748
01/02/2014	28/02/2014	1,171	0	25	0.1	26,344
01/03/2014	31/03/2014	1,257	0	25	0.1	28,272
01/04/2014	30/04/2014	1,126	0	25	0.1	25,337
01/05/2014	31/05/2014	1,104	0	25	0.1	24,844
01/06/2014	30/06/2014	1,212	0	25	0.1	27,269
01/07/2014	31/07/2014	1,258	0	25	0.1	28,311
01/08/2014	31/08/2014	1,245	0	25	0.1	28,006
01/09/2014	30/09/2014	1,253	0	25	0.1	28,190
01/10/2014	31/10/2014	1,295	0	25	0.1	29,138

Table 5 Project emissions from consumption of fossil fuels (Diesel generator)

Date		Quantity of fuel combustion (Diesel) (litres)	Net calorific value of Diesel (GJ/litre)	CO_2 emission factor of Diesel (tCO_2/GJ)	CO_2 emission coefficient of Diesel ($tCO_2/litre$)	Project emission from fossil fuels consumption (tCO_2e)
		$FC_{i,j,y}$	$NCV_{i,y}$	$EF_{CO2,i,y}$	$COEF_{i,y}$	$PE_{FC,j,y}$
01/10/2013	31/10/2013	0.00	0.03642	0.07480	0.0027242	0.00
01/11/2013	30/11/2013	0.00	0.03642	0.07480	0.0027242	0.00
01/12/2013	31/12/2013	0.00	0.03642	0.07480	0.0027242	0.00
01/01/2014	31/01/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/02/2014	28/02/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/03/2014	31/03/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/04/2014	30/04/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/05/2014	31/05/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/06/2014	30/06/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/07/2014	31/07/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/08/2014	31/08/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/09/2014	30/09/2014	0.00	0.03642	0.07480	0.0027242	0.00
01/10/2014	31/10/2014	0.00	0.03642	0.07480	0.0027242	0.00

Table 6 Project emission from consumption of electricity

Date		Amount of electricity imported from the grid and used in the project (MWh)	CO_2 emission factor for electricity generation (tCO_2e/MWh)	Average technical transmission and distribution losses for providing electricity to the project	Project emission from electricity consumption (tCO_2e)
		$EC_{PJ,y}$	$EF_{EL,j,y}$	$TDL_{j,y}$	$PE_{EC,y}$
01/10/2013	31/10/2013	0.36	0.5113	9.16%	0.20
01/11/2013	30/11/2013	0.12	0.5113	9.16%	0.07
01/12/2013	31/12/2013	0.12	0.5113	9.16%	0.07
01/01/2014	31/01/2014	0.00	0.5113	9.16%	0.00
01/02/2014	28/02/2014	0.48	0.5113	9.16%	0.27
01/03/2014	31/03/2014	0.36	0.5113	9.16%	0.20
01/04/2014	30/04/2014	0.24	0.5113	9.16%	0.13
01/05/2014	31/05/2014	1.20	0.5113	9.16%	0.67
01/06/2014	30/06/2014	1.08	0.5113	9.16%	0.60
01/07/2014	31/07/2014	0.12	0.5113	9.16%	0.07
01/08/2014	31/08/2014	1.20	0.5113	9.16%	0.67
01/09/2014	30/09/2014	0.12	0.5113	9.16%	0.07
01/10/2014	31/10/2014	0.36	0.5113	9.16%	0.20

Table 7 Total Project emissions

Date		Project emission from electricity consumption (tCO_2e)	Project emission from fossil fuels consumption (tCO_2e)	Project emissions (tCO_2e)
		$PE_{EC,y}$	$PE_{FC,j,y}$	PE_y
01/10/2013	31/10/2013	0.20	0.00	0.20
01/11/2013	30/11/2013	0.07	0.00	0.07
01/12/2013	31/12/2013	0.07	0.00	0.07
01/01/2014	31/01/2014	0.00	0.00	0.00
01/02/2014	28/02/2014	0.27	0.00	0.27
01/03/2014	31/03/2014	0.20	0.00	0.20
01/04/2014	30/04/2014	0.13	0.00	0.13
01/05/2014	31/05/2014	0.67	0.00	0.67
01/06/2014	30/06/2014	0.60	0.00	0.60
01/07/2014	31/07/2014	0.07	0.00	0.07
01/08/2014	31/08/2014	0.67	0.00	0.67
01/09/2014	30/09/2014	0.07	0.00	0.07
01/10/2014	31/10/2014	0.20	0.00	0.20

Table 8 Total GHG Emission reductions of the monitoring period

Date		Baseline emissions (tCO_2e)	Project emissions (tCO_2e)	Leakage (tCO_2e)	Emission reductions (tCO_2e)
		BE_y	PE_y	LE_y	ER_y
01/10/2013	31/10/2013	32,275	0.20	0	32,275
01/11/2013	30/11/2013	30,706	0.07	0	30,706
01/12/2013	31/12/2013	32,767	0.07	0	32,767
01/01/2014	31/01/2014	32,894	0.00	0	32,894
01/02/2014	28/02/2014	29,166	0.27	0	29,166
01/03/2014	31/03/2014	31,344	0.20	0	31,344
01/04/2014	30/04/2014	28,225	0.13	0	28,225
01/05/2014	31/05/2014	27,788	0.67	0	27,787
01/06/2014	30/06/2014	30,133	0.60	0	30,132
01/07/2014	31/07/2014	31,365	0.07	0	31,365
01/08/2014	31/08/2014	31,033	0.67	0	31,032
01/09/2014	30/09/2014	31,176	0.07	0	31,176
01/10/2014	31/10/2014	32,301	0.20	0	32,300

Table 9 Summary of GHG Emission reductions of the monitoring period

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	**401,171**	**4**	**-**	**401,167**

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

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	**CASE B** 2013 = 184,492 x 92 / 365 = 46,502 2014 = 142,343 x 304 / 365 = 118,554 **Total Monitoring Period = 165,056**	**401,167**

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

CASE A, which estimated ex-ante emission reductions in the registered GS PDD version 16 and its ER spreadsheet, is based on waste tipping stopping in mid-2014 is different to the actual situation. CASE B included in the GS ER spreadsheet (which assumes the waste tipping contract is extended until the available void space is filled) is more appropriate for comparison with the actual situation and estimates a total of 165,056 tCO_2e for the current monitoring period (calculation as per table section E.5). **401,167** tCO_2e have actually been generated during the current monitoring period which is 143.04% higher than the estimated value. Any increase is due to higher amount of waste tipped, higher gas generation and collected (and therefore number of engines assumed) and better operational performance to date compared to that envisaged at this stage in the CASE B included in the GS ER spreadsheet of registered GS PDD version 16.

The table below presents actual waste tipping, gas collected and engine operational hours during this monitoring period 1st October 2013 to 31st October 2014 compared to CASE B included in the GS ER spreadsheet of registered GS PDD version 16.

Item	Amount of waste tipped (Tons)	Methane collected (Nm3)	Average daily engine operational hours (hours/day)*
Actual value achieved during this monitoring period	819,905.73	22,474,861	22.90
GS PDD (CASE B)	2013 = 751,981 x 92/365 = 189,540 2014 = 751,981 x304/365 = 626,307 **Total = 815,847**	2013 = 10,244,811 x 92/365 = 2,582,254 2014 = 10,441,718 x 304/365 = 8,696,663 **Total = 11,278,917**	2013 = 7,200/365 = 19.7 2014 = 7,200/365 = 19.7 **Average = 19.7**

*Average daily engine operational hours during previous monitoring period from 1st April 2012 to 30th September 2013 is 21.5 hours/day.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	N/A	656,182

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

Project participant and/or responsible person/ entity	☒ Project participant ☒ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Sindicatum Carbon Capital Ltd
Street/P.O. Box	25 Eccleston Place
Building	
City	London
State/Region	
Postcode	SW1W 9NF
Country	UK
Telephone	+65 67328897
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E-mail	ccregistration@carbon-capital.com
Website	www.sindicatum.com
Contact person	Jay Mariyappan
Title	Managing Director, Delivery
Salutation	Mr
Last name	Mariyappan
Middle name	
First name	Jay
Department	
Mobile	
Direct fax	+65 67328897
Direct tel.	+65 67329767
Personal e-mail	jay.mariyappan@sindicatum.com

Annex A. Emission Reduction Calculation Sheets

Separate emission reductions calculation spreadsheets have been provided for the purpose of verification.

Annex B. Flare Efficiency

The determination of project emissions from flaring is described in the registered GS PDD page 25 onwards.

Determination of the of flare efficiency in minute *m*:

In the case of enclosed flares are used in this project activity, and Option A: Apply a default value for flare efficiency is selected from the tool "Project emissions from flaring" (Version 02.0.0).

Option A: Default value

The flare efficiency for the minute *m* ($\eta_{flare,\,m}$) is 90% when the following two conditions are met to demonstrate that the flare is operating:

1) The temperature of the flare ($T_{EG,m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute *m* and
2) The flame is detected in minute *m* ($Flame_m$)

Otherwise $\eta_{flare,\,m}$ is 0%.

Annex C. Monitored Laws and Regulations

Regulation	Impact	Date of application
Public Health Act 1992	Stated in PDD. Governs the operation of the landfill and provides a mechanism for regulation by local administrative body via the issuance of the license to the landfill. Thung Bua Sub-district Administrative Organisation has not currently set out and specific regulations relating to the license. No impact on parameters monitored during the current crediting period.	1992
Act of Cleanliness and Tidiness of the Nation 1992	Has no requirement for LFG control, extraction or utilisation. No impact on parameters monitored during the current crediting period.	1992
Public Health Act (Issue 2) 2007	Repealed section 18 of Public Health Act 1992 and enforce section 9 of this act. Governs the operation of the landfill provides a mechanism for regulation by local administrative body via the issuance of the license to the landfill and not apply this amended law to the disposal of hazardous waste as defined by the factory laws. Currently, Thung Bua Sub-district Admistrative Organisation has not set out and announced the specific regulations relating to the license. No impact on parameters monitored during the current crediting period.	2007

Annex D. Specification of GS CDM Monitoring Equipment

Parameter	Instrument Type	Manufacturer	Instrument Model	Instrument Range	Accuracy	Calibration Requirements
LFG_{total} ($V_{t,db}$)	V-Cone Flow Meter	Kingways	KVS14IIKD23FSN with Rosemount 3051 CD Differential Pressure Transmitter	750 - 7500 $m.^3$/hr.	±0.5%	2 yearly
		Shanghai Kent	KVCFF-350-AON/2 (PN10) with Rosemount 3051 CD Differential Pressure Transmitter	750 - 7500 $m.^3$/hr.	±0.5%	2 yearly
LFG_{flare} ($V_{t,db}$)	V-Cone Flow Meter	Kingways	KVS08IIKC23FSN with Rosemount 3051 CD Differential Pressure Transmitter	250 - 2500 $m.^3$/hr.	±0.5%	2 yearly
		KVS Lamways	RVM-VS08IIJF63N2 with Rosemount 3051 CD Differential Pressure Transmitter	250 - 2500 $m.^3$/hr.	±0.5%	2 yearly
$LFG_{electricity,}$ ($V_{t,db}$)	V-Cone Flow Meter	Kingways	KVS06IIKC23FSN with Rosemount 3051 CD Differential Pressure Transmitter	200 - 2000 $m.^3$/hr.	±0.5%	2 yearly
		Kingways	KVS06IIKC23FSN with Rosemount 3051 CD Differential Pressure Transmitter	100 - 1000 $m.^3$/hr.		
		KVS Lamways	RVM-VS06JF63N2 with Rosemount 3051 CD Differential Pressure Transmitter			
		Shanghai Kent	KVCFF150CD1N/6 with Rosemount 3051 CD Differential Pressure Transmitter			
$v_{i,t,db}$	Infra Red Gas Analyser	Edinburgh Instruments Limited	Guardian Plus Infra-Red Gas Monitor	0 - 100%	± 2.5% Full Scale Deflection	Annually
			Guardian NG Infra-Red Gas Monitor			
T_t	Temperature Transmitter	Honeywell	STT830-171	- 58 to 500˚C	± (0.3+0.005|T|)˚C	Annually
P_t	Absolute Pressure Transmitter	Rosemount	Model 3051TA	0 - 207 kPa	± 0.075 % of span	Annually
EG_{PJ}	Electric Meter	EDMI	EDMI-Mk6 (Genius)	-	Class 0.5S	Annually
EC_{PJ}	Electric Meter	EDMI	EDMI-Mk6 (Genius)	-	Class 0.5S	Annually
TEG_m	Type N Thermocouple	Honeywell	STT830-173	0 - 1200˚C	Accuracy Class II (allowable deviation ±(0.0075|t|))	Annually
		Uniflare	32-N-LTS-176-6.0-2I-TXLIN/EXI	0 - 1300˚C	Accuracy Class II (allowable deviation ±(0.0075|t|))	Annually
$Flame_m$	UV flame detector	Honeywell	C7027A	-18 to 102˚C	-	No requirement

Annex E. GS CDM Monitoring Equipment Installation and Calibration Dates

Notes:

1. All monitoring euipment calibration records shown in table below are within the monitoring period of 01/10/2013 to 31/10/2014.
2. Since LFG flow monitoring equipment consist of 2 components i.e. V-cone flow meter and differential pressure transmitter. Therefore, FT9261A, FT9261B, FT9391-FT9591 and EFT9001- EFT9008 serial no. information are presented as
   "Serial no. of V-cone flow meter / serial no. of differential pressure transmitter"
3. "Equipment Start Date" and "Equipment End Date" mean the installation period of the individual equipment over the current monitoring period.
4. For EG_{PJ}, the electricity primary and secondary meter serial no.205610065/PEA19936922 and serial no. 205610126/PEA19936983 Are the PEA's electricity meters which used for temporary during PEA calibrate the permanent export meter.
5. For EC_{PJ}, the electricity primary and secondary meter serial no. 205610067/PEA19936924 is the PEA's electricity meter which used for temporary during PEA calibration the permanent import meter.
6. If the PEA registered no. (PEA no.) of any power meter used for monitoring the parameter EL_{export} and EL_{import} are available, the serial no. information are presented as
   "Serial no. of power meter / PEA no. of power meter"

Name	Tag No.	Serial No.	Equipment Start Date	Equipment End Date	Calibration Certification Validity Period	Certificate Reference
LFG_{Total} ($V_{t,db}$)	FT 9261 A	9061213 / 5058731	01/10/2013	27/11/2013	2011-12-01 to 2013-11-30	D11-1128-JG
		9061212 / 5058730	27/11/2013	21/10/2015	2013-10-22 to 2015-10-21	D13-740-JG-01
	FT 9261 B	KT13050301399 / 02886985	01/10/2013	04/06/2015	2013-06-05 to 2015-06-04	D13-415-JG
LFG_{Flare} ($V_{t,db}$)	FT 9391	9062916 / 5058745	01/10/2013	24/06/2015	2013-06-25 to 2015-06-24	LC1306-087
	FT 9491	10071510 / 5476731	01/10/2013	18/04/2015	2013-04-19 to 2015-04-18	L1304-375
	FT 9591	10071509 / 4959893	01/10/2013	18/04/2015	2013-04-19 to 2015-04-18	L1304-374
$LFG_{Electricity}$ ($V_{t,db}$)	EFT 9001	10071503 / 5058744	01/10/2013	29/09/2014	2012-10-01 to 2014-09-30	L1210-028
		10071504 / 5476737	29/09/2014	22/12/2015	2013-12-23 to 2015-12-22	L1312-210
	EFT 9002	10071504 / 5476737	01/10/2013	04/11/2013	2011-11-07 to 2013-11-06	LC1111-081
		9062914 / 5058767	04/11/2013	29/08/2015	2013-08-30 to 2015-08-29	LC1308-105
	EFT 9003	10071505 / 5476725	01/10/2013	18/04/2015	2013-04-19 to 2015-04-18	L1304-376
	EFT 9004	10071506 / 4964086	01/10/2013	18/04/2015	2013-04-19 to 2015-04-18	L1304-377
	EFT 9005	9062907 / 5058760	01/10/2013	23/06/2015	2013-06-24 to 2015-06-23	LC1306-090
	EFT 9006	9062903 / 5058756	01/10/2013	23/06/2015	2013-06-24 to 2015-06-23	LC1306-089
	EFT 9007	10071502 / 5615483	01/10/2013	18/04/2015	2013-04-19 to 2015-04-18	L1304-372
	EFT 9008	9062901 / 5058746	01/10/2013	23/06/2015	2013-06-24 to 2015-06-23	LC1306-088
$V_{i,t,db}$	CH_4 9261 A	29690	01/10/2013	20/01/2014	2013-01-24 to 2014-01-23	C1301-1053
		4229	20/01/2014	20/01/2014	2013-10-30 to 2014-10-29	1580
		29690	20/01/2014	23/01/2014	2013-01-24 to 2014-01-23	C1301-1053
		4229	23/01/2014	23/01/2014	2013-10-30 to 2014-10-29	1580
		29684	23/01/2014	19/02/2014	2013-08-14 to 2014-08-13	1552
		31426	19/02/2014	21/06/2014	2014-01-30 to 2015-01-29	L1401-458

		31421	21/06/2014	09/08/2014	2014-04-17 to 2015-04-16	1677
		31421	09/08/2014	31/10/2014	2014-08-09 to 2015-08-09	L1408-186

Annex E. CDM Monitoring Equipment Installation & Calibration Dates (Cont.)

Name	Tag No.	Serial No.	Equipment Start Date	Equipment End Date	Calibration Certification Validity Period	Certificate Reference
T_t	TT 9231	090333253	01/10/2013	04/08/2014	2013-08-07 to 2014-08-06	13/2126
		080625406	04/08/2014	29/01/2015	2014-01-30 to 2015-01-29	14/0228
	TT 9261 A	080625360	01/10/2013	15/07/2014	2013-07-16 to 2014-07-15	13/1864
		080638016	15/07/2014	14/07/2015	2014-07-15 to 2015-07-14	14/1706
	TT 9261 B	080625355	01/10/2013	15/07/2014	2013-07-16 to 2014-07-15	13/1863
		100208514	15/07/2014	14/07/2015	2014-07-15 to 2015-07-14	14/1705
	TT 9391	100208523	01/10/2013	15/07/2014	2013-07-16 to 2014-07-15	13/1865
		080625397	15/07/2014	14/07/2015	2014-07-15 to 2015-07-14	14/1703
	TT 9491	090536657	01/10/2013	15/07/2014	2013-07-16 to 2014-07-15	13/1867
		080625432	15/07/2014	14/07/2015	2014-07-15 to 2015-07-14	14/1704
	TT 9591	080625400	01/10/2013	15/07/2014	2013-07-16 to 2014-07-15	13/1866
		080638034	15/07/2014	14/07/2015	2014-07-15 to 2015-07-14	14/1704
	ETT 9001	090536658	01/10/2013	19/02/2014	2013-02-22 to 2014-02-21	13/0388
		080638031	19/02/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0312
	ETT 9002	080638031	01/10/2013	05/11/2013	2012-11-05 to 2013-11-04	12/2383
		100208537	05/11/2013	15/07/2014	2013-08-05 to 2014-08-04	13/2127
		090536658	15/07/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0313
	ETT 9003	080638042	01/10/2013	05/11/2013	2012-11-05 to 2013-11-04	12/2384
		100208540	05/11/2013	15/07/2014	2013-08-05 to 2014-08-04	13/2128
		090543121	15/07/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0314
	ETT 9004	080638069	01/10/2013	05/11/2013	2012-11-05 to 2013-11-04	12/2385
		100208541	05/11/2013	15/07/2014	2013-08-05 to 2014-08-04	13/2129
		090536683	15/07/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0316
	ETT 9005	090543121	01/10/2013	19/02/2014	2013-02-22 to 2014-02-21	13/0393
		100098212	19/02/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0309
	ETT 9006	090536683	01/10/2013	19/02/2014	2013-02-22 to 2014-02-21	13/0391
		080638042	19/02/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0308
	ETT 9007	090543120	01/10/2013	19/02/2014	2013-02-22 to 2014-02-21	13/0390
		100211940	19/02/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0311
	ETT 9008	100211940	01/10/2013	18/02/2014	2013-02-22 to 2014-02-21	13/0389
		100208515	18/02/2014	15/07/2014	2013-08-05 to 2014-08-04	13/2131
		090543120	15/07/2014	18/02/2015	2014-02-19 to 2015-02-18	14/0315
P_t	PT 9261 A	5466080	01/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-250
		5466002	03/06/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-257
	PT 9261 B	5466089	01/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-251
		5466003	03/06/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-258
	PT 9391	5466010	01/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-254
		5466004	03/06/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-259
	PT 9491	5466007	01/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-255
		5466006	03/06/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-260
	PT 9591	5466015	01/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-256
		5466083	03/06/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-265
	EPT 9001	02300672	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-111
		02443480	29/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-260

		02150753	03/06/2014	24/10/2014	2013-10-29 to 2014-10-28	C1310-1073
		02443480	24/10/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-252

Annex E. CDM Monitoring Equipment Installation & Calibration Dates (Cont.)

Name	Tag No.	Serial No.	Equipment Start Date	Equipment End Date	Calibration Certification Validity Period	Certificate Reference
P_t	EPT 9002	02300674	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-113
		02443481	29/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-261
		02150751	03/06/2014	24/10/2014	2013-10-29 to 2014-10-28	C1310-1074
		02443481	24/10/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-253
	EPT 9003	02150753	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-106
		02715553	29/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-262
		02166916	03/06/2014	24/10/2014	2013-10-29 to 2014-10-28	C1310-1075
		02715553	24/10/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-254
	EPT 9004	02150751	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-107
		02777923	29/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-263
		02150750	03/06/2014	24/10/2014	2013-10-29 to 2014-10-28	C1310-1076
		02777923	24/10/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-255
	EPT 9005	02300673	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-112
		02777924	29/10/2013	03/06/2014	2013-06-05 to 2014-06-04	C1306-264
		02166915	03/06/2014	24/10/2014	2013-10-29 to 2014-10-28	C1310-1077
		02777924	24/10/2014	02/06/2015	2014-06-03 to 2015-06-02	C1406-255
	EPT 9006	02150750	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-109
		02300672	29/10/2013	24/10/2014	2013-10-29 to 2014-10-28	C1310-1078
		02150753	24/10/2014	23/10/2015	2014-10-24 to 2015-10-23	C1410-2444
	EPT 9007	02166915	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-110
		02300673	29/10/2013	24/10/2014	2013-10-29 to 2014-10-28	C1310-1079
		02150751	24/10/2014	23/10/2015	2014-10-24 to 2015-10-23	C1410-2446
	EPT 9008	02166916	01/10/2013	29/10/2013	2012-11-05 to 2013-11-04	C1211-108
		02300674	29/10/2013	24/10/2014	2013-10-29 to 2014-10-28	C1310-1080
		02166916	24/10/2014	23/10/2015	2014-10-24 to 2015-10-23	C1410-2447
EG_{PJ}	Primary	201005194/ PEA 15850695	01/10/2013	02/07/2014	2013-07-03 to 2014-07-02	-
		205610067/ PEA 19936924	02/07/2014	02/07/2014	2013-08-02 to 2014-08-01	-
		201005194/ PEA 15850695	02/07/2014	01/07/2015	2014-07-02 to 2015-07-01	-
	Secondary	212607309	01/10/2013	02/07/2014	2013-07-03 to 2014-07-02	-
		205610067/ PEA 19936924	02/07/2014	02/07/2014	2013-08-02 to 2014-08-01	-
		212607309	02/07/2014	01/07/2015	2014-07-02 to 2015-07-01	-
EC_{PJ}	Primary	201006718/ PEA 15852219	01/10/2013	02/07/2014	2013-07-03 to 2014-07-02	-
		205610126/ PEA 19936983	02/07/2014	02/07/2014	2013-08-02 to 2014-08-01	-
		201006718/ PEA 15852219	02/07/2014	01/07/2015	2014-07-02 to 2015-07-01	-
	Secondary	210422526	01/10/2013	02/07/2014	2013-07-03 to 2014-07-02	-
		205610126/ PEA 19936983	02/07/2014	02/07/2014	2013-08-02 to 2014-08-01	-
		210422526	02/07/2014	01/07/2015	2014-07-02 to 2015-07-01	-

Annex E. CDM Monitoring Equipment Installation & Calibration Dates (Cont.)

Name	Tag No.	Serial No.	Equipment Start Date	Equipment End Date	Calibration Certification Validity Period	Certificate Reference
TEG_m	TTC 9393A	080614373	01/10/2013	08/07/2014	2013-07-16 to 2014-07-15	13/1860
		080614321	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0814
	TTC 9393B	090326012	01/10/2013	08/07/2014	2013-07-16 to 2014-07-15	13/1861
		090326010	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0817
	TTC 9393 C	090326013	01/10/2013	08/07/2014	2013-07-16 to 2014-07-15	13/1862
		080614298	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0815
	TTC 9493 A	080614290	01/10/2013	18/02/2014	2013-02-21 to 2014-02-20	13/0381
		090326007	18/02/2014	08/07/2014	2013-08-14 to 2014-08-13	13/2119
		080614290	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0812
	TTC 9493 B	080614323	01/10/2013	18/02/2014	2013-03-06 to 2014-03-05	13/0511
		080614289	18/02/2014	08/07/2014	2013-08-08 to 2014-08-07	13/2113
		080614323	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0813
	TTC 9493 C	080614298	01/10/2013	18/02/2014	2013-02-21 to 2014-02-20	13/0382
		080614306	18/02/2014	08/07/2014	2013-08-13 to 2014-08-12	13/2116
		090326006	08/07/2014	21/03/2015	2014-03-22 to 2015-03-21	14/0816
	TTC 9593 A	090326006	01/10/2013	18/02/2014	2013-02-21 to 2014-02-20	13/0380
		090329527	18/02/2014	08/07/2014	2013-08-08 to 2014-08-07	13/2121
		080614379	08/07/2014	01/07/2015	2014-07-02 to 2015-07-01	14/1516
	TTC 9593 B	090326010	01/10/2013	18/02/2014	2013-03-06 to 2014-03-05	13/0512
		080614305	18/02/2014	08/07/2014	2013-08-13 to 2014-08-12	13/2115
		090326009	08/07/2014	01/07/2015	2014-07-02 to 2015-07-01	14/1517
	TTC 9593 C	080614321	01/10/2013	18/02/2014	2013-03-06 to 2014-03-05	13/0510
		080614320	18/02/2014	08/07/2014	2013-08-13 to 2014-08-12	13/2117
		090329544	08/07/2014	01/07/2015	2014-07-01 to 2015-06-30	14/1518
Flame $_m$	BT9393	-	01/10/2013	31/10/2014	-	-
	BT9493	-	01/10/2013	31/10/2014	-	-
	BT9593	-	01/10/2013	31/10/2014	-	-

Annex F. Special Events Table

Start Time (UTC)	Finish Time (UTC)	Downtime (hr:mm)	DESCRIPTION OF EVENT	Impact on ER Calculation
05/10/2013 01:30	06/10/2013 10:15	32:46	Stopped for Engine 3 due to Change intercooler, Cylinder head # 16, Change engine lube oil, Maintenance 26,000 hrs. running service	No methane destruction by the Engine 3
21/10/2013 02:28	22/10/2013 04:51	26:24	Stopped for Engine 5 due to Change Intercooler	No methane destruction by the Engine 5
11/11/2013 01:52	15/11/2013 03:46	97:55	Stopped for Engine 5 due to Maintenance 20,000 hrs. Running service	No methane destruction by the Engine 5
21/11/2013 04:45	22/11/2013 04:49	24:05	Stopped for Engine 3 due to Generator overload/ short circuit	No methane destruction by the Engine 3
01/12/2013 20:24	04/12/2013 12:09	63:46	Stopped for Engine 4 due to Maintenance De - Coke / Clean cylinder head and Piston	No methane destruction by the Engine 4
05/12/2013 01:14	06/12/2013 05:25	28:12	Stopped for Engine 1 due to Change Inter cooler	No methane destruction by the Engine 1
09/12/2013 01:49	13/12/2013 03:48	98:00	Stopped for Engine 6 due to Maintenance 20,000 hrs. Running service	No methane destruction by the Engine 6
09/12/2013 08:54	10/12/2013 09:53	25:00	Stopped for Engine 8 due to Change cylinder head No.17, 20	No methane destruction by the Engine 8
27/01/2014 01:25	05/02/2014 04:27	219:03	Stopped for Engine 8 due to Maintenance De - Coke	No methane destruction by the Engine 8
29/01/2014 04:59	31/01/2014 04:03	47:05	Stopped for Engine 2 due to Change generator	No methane destruction by the Engine 2
03/02/2014 01:26	06/02/2014 09:00	79:35	Stopped for Engine 7 due to Maintenance De - Coke	No methane destruction by the Engine 7
23/04/2014 13:29	25/04/2014 07:36	42:08	Stopped for Engine 4 due to O-ring cylinder head No. 10 Leak / Change Cylinder Head#10,15,20	No methane destruction by the Engine 4
28/04/2014 02:22	29/04/2014 08:40	30:19	Stopped for Engine 8 due to Change Inter Cooler	No methane destruction by the Engine 8
05/05/2014 01:02	08/05/2014 14:09	85:08	Stopped for Engine 2 due to Maintenance 30,000 hrs. Running service	No methane destruction by the Engine 2
14/05/2014 01:12	15/05/2014 07:34	30:23	Stopped for Engine 7 due to Change Inter Cooler & Turbo Charger	No methane destruction by the Engine 7
15/06/2014 00:45	16/06/2014 14:30	37:46	Stopped for Engine 1 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 1
15/06/2014 00:45	16/06/2014 14:19	37:35	Stopped for Engine 2 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 2
15/06/2014 00:45	16/06/2014 14:17	37:33	Stopped for Engine 3 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 3
15/06/2014 00:45	16/06/2014 14:26	37:42	Stopped for Engine 4 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 4
15/06/2014 00:46	16/06/2014 14:34	37:49	Stopped for Engine 5 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 5
15/06/2014 00:46	16/06/2014 14:04	37:19	Stopped for Engine 6 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 6
15/06/2014 00:47	16/06/2014 14:16	37:30	Stopped for Engine 7 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 7
15/06/2014 00:47	16/06/2014 14:37	37:51	Stopped for Engine 8 due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Engine 8
15/06/2014 00:45	16/06/2014 14:06	37:22	Stopped for Flare due to PEA Service Maintenance & Repair Switch gear	No methane destruction by the Flare
14/07/2014 01:34	17/07/2014 06:20	76:47	Stopped for Engine 3 due to Maintenance 32,000 hrs. Running service	No methane destruction by the Engine 3
28/07/2014 01:06	01/08/2014 04:27	99:22	Stopped for Engine 8 due to Maintenance 20,000 hrs. Running service	No methane destruction by the Engine 8
18/08/2014 00:38	21/08/2014 09:44	81:07	Stopped for Engine 1 due to Maintenance 32,000 hrs. Running service	No methane destruction by the Engine 1
01/09/2014 00:50	05/09/2014 03:52	99:03	Stopped for Engine 7 due to Maintenance 20,000 hrs. Running service	No methane destruction by the Engine 7
04/10/2014 16:32	06/10/2014 3:31	35:00	Stopped for Engine 8 due to Cylinder exhaust gas temp failure / Exh. Gas temp deviation low / Check NOx	No methane destruction by the Engine 8

Annex G. Sustainable Development Indicators Monitoring

The following tables show monitoring data of sustainable development indicators as stated in Section G. Sustainability Monitoring Plan of the GS Passport during the current monitoring period.

<table>
<tr><td>No</td><td>1</td></tr>
<tr><td>Indicator</td><td>Air quality</td></tr>
<tr><td>Mitigation measure</td><td>Reduction of baseline SO_2 and NO_x emissions: The Project, by replacing electricity from fossil fuel combustion and the related fuel consumption, reduces the baseline SO_2 and NO_x emissions from electricity generation. The emission reductions of SO_2 and NO_x will be calculated by multiplying net electricity generation from the project activity with SO_2 and NO_x emission factors using publicly available information.
Using engines with suitable low emissions. Stack emissions are below the local requirements stipulated in the Initial Environmental Evaluation and checked regularly by local authorities</td></tr>
<tr><td>Chosen parameter</td><td>a) SO_2 reductions
b) NO_x reductions
c) Stack emissions below local/IEE requirements</td></tr>
<tr><td>Current situation of parameter</td><td>Parameter a) and b), Since 70,276MWh of electricity have been generated during the current monitoring period. Therefore, SO_2 and NO_x emission have been reduced 1.41 tons of SO_2 and 86.16 tons of NO_x respectively through this monitoring period. The demonstrating of air quality improvement by the project activity is stated by the comparison table of SO_2 and NO_x emission generated approached to project’s emission factor and Thailand baseline emission factor as below.

<table>
<tr><th>Air emission factor for the monitoring period</th><th>SO_2 emission factor (g/kWh)</th><th>NO_x emission factor (g/kWh)</th></tr>
<tr><td>Thailand baseline emission factor</td><td>0.410</td><td>1.26</td></tr>
<tr><td>Average Project's stack emission factor</td><td>0.02</td><td>1.23</td></tr>
</table>

<table>
<tr><th>Air emission reductions by the project activity for the monitoring period</th><th>SO_2 emission reductions (Ton-SO_2)</th><th>NO_x emission reductions (Ton-NO_x)</th></tr>
<tr><td>Approached to Thailand baseline emission factor</td><td>28.81</td><td>88.55</td></tr>
<tr><td>Approached to Project's emission factor</td><td>1.41</td><td>86.16</td></tr>
</table>

Reference:
- Journal of Sustainable Energy & Environmental 2 (2011) Emission Inventory of Electricity Generation in Thailand
- Environmental Monitoring Report of 2nd/2013, Tested date: November 25-29, 2013 and 1st/2014, Tested date: June 16-20 & July 19-22, 2014 prepared by Intertek Testing Services (Thailand) Limited</td></tr>
</table>

Parameter c), Annual stack emissions monitoring has been performed regarding IEE requirement on 1.) November 25-29, 2013 and 2.) June 16-20 & July 19-22, 2014. Air emissions from the project comply with local requirements, and therefore, mitigation measures were sufficient. The analysis result present as table below.

Engine no.	SO_2 emission results (ppm)	SO_2 emission results (ppm)	Standard SO_2[2] (ppm)	NO_x emission results (ppm)	NO_x emission results (ppm)	Standard NO_x as NO_2[2] (ppm)	Standard Compliance
	November 25-29, 2013	June 16-20 & July 19-22, 2014		November 25-29, 2013	June 16-20 & July 19-22, 2014		
E1	1.5	0.452	**60**	98.672	165.145	**200**	Complied
E2	1.4	1.738	**60**	112.784	163.958	**200**	Complied
E3	1.4	2.712	**60**	84.473	154.038	**200**	Complied
E4	1.5	2.029	**60**	115.028	148.179	**200**	Complied
E5	1.4	0.675	**60**	111.51	144.734	**200**	Complied
E6	1.5	1.069	**60**	130.58	143.054	**200**	Complied
E7	1.5	2.376	**60**	118.351	143.284	**200**	Complied
E8	1.5	2.140\	**60**	97.85	157.806	**200**	Complied

Reference: Environmental Monitoring Report of 2nd/2013, Tested date: November 25-29, 2013 and 1st/2014, Tested date: June 16-20 & July 19-22, 2014 prepared by Intertek Testing Services (Thailand) Limited

Estimation of baseline situation of parameter	Before the project is implemented, emissions were emitted due to electricity generated by grid which will now be displaced by the project. Multiply the expected annual electricity generated by the project by the SO_2 and NO_x emission factors	
Future target for parameter	To reduce SO_2 and NO_x emissions in Thailand by displacing fossil fuel generated electricity with electricity from the project activity, thereby contributing to improved air quality.	
Way of monitoring	How	Chosen parameter a) SO_2 reductions and b) NO_x reductions will calculated by multiplying the net electricity generation of the Project with SO_2 and NO_x emission factors for Thailand SO_2 emission factor is 0.41g/kWh NO_x emission factor is 1.26 g/kWh Reference: Journal of Sustainable Energy & Environment 2 (2011) Emission Inventory of Electricity Generation in Thailand Chosen parameter c) Measured by standard method regarding to local requirements

[2] The notification of the Ministry of Industry, B.E. 2547 (2004), Emission Standards for Power Plants (New Power Plant - Biogas fuel),Published in the Royal Government Gazette, Vol. 121, Part 113D date October 7, B.E.2547 (2004). The concentrations of air emission are based on the reference condition 25 C at 1 atm (760 mmHg) dry basic and 7 % oxygen content.S

Way of monitoring	When	Parameter a) and b) During the current monitoring period Parameter c) November 25-29, 2013 and June 16-20 & July 19-22, 2014
	By who	Parameter a) and b) Bangkok Greenpower; Project owner. Parameter c) Intertek Testing Services (Thailand) Limited

No	2
Indicator	Other pollutants
Mitigation measure	Noise pollution will be mitigated by sourcing engine, pretreatment and flares that will meet local noise requirements
Chosen parameter	Noise levels
Current situation of parameter	Noise and nuisance levels have been tested every year since the start of operation by local authorities. Annual noise level monitoring performed on November 25-29, 2013 and June 16-20 & July 19-22, 2014. The noise test report has shown that the project activity has so far been in compliance with local requirements and the IEE.

Parameter	**Noise level (dBA)**	**Standard compliance**	**Noise level (dBA)**	**Standard compliance**	**Standard Noise and Nuisance level[3]**
	November 25-29, 2013		July 19-22, 2014		**dBA**
Equivalents sound level (L_{eq} 24 hr)	66.1 - 67.4	Complied	67.4-67.8	Complied	70
Maximum sound level (L_{max})	93.8 - 96.4	Complied	75.4-98.6	Complied	115
Nuisance noise	6.1 - 7.9	Complied	13.5 - 13.9	*Exceeded	10

Reference: Environmental Quality Monitoring Report of 2nd/2013, Tested date: November 25-29, 2013 and 1st/2014, Tested date: June 16-20 & July 19-22, 2014 prepared by Intertek Testing Services (Thailand) Limited was conducted based on World Bank request at Page 24 of the Environmental Quality Monitoring Report 1st/2014 Bangkok Greenpower Co., Ltd., a map illustrates the monitoring location of nuisance tested on July 19-22, 2014 that it is located at 2.41 kilometres distance from the project activity. Intertek Testing Services (Thailand) has explained the analysis of the non-compliance results as below;

"Result of annoyance noise was found to be 13.5-13.9 dB(A) was exceeding with the notification of the National Environment Board No.29, regarding annoyance noise standard, B.E. 2550 (2007), which has a regulation standard of annoyance noise not to be greater than 10 dB(A). However, the annoyance noise in Wat Pho-ngam School may be occurred from activities from community near the

[3] 1) The Notification of the National Environmental Board No. 15, Regarding Community Noise Standard, B.E. 2540 (1997). 2) The Notification of the National Environmental Board No. 29, Regarding Annoyance Noise Standard, B.E. 2550 (2007). 3) The Notification of the Ministry of Industry Regarding Annoyance Noise from Factory Standard, B.E. 2548 (2005).

	school more than project site (Bangkok Greenpower site distance from Wat Pho-ngam School more than 2 kilometers). So, the annoyance noise from site was not affected with Wat Pho-ngam School." *According to section 3.1.4 of the "Guidelines for Preparing Report on Initial Environmental Evaluation (IEE) and Self-Evaluation on Sustainable Development of CDM Projects in Thailand" the distance for noise test is 500m radius of the project site. The above request by World Bank does not comply with local requirements.	
Estimation of baseline situation of parameter	No noise	
Future target for parameter	To keep noise levels within the local requirements	
Way of monitoring	How	Measured by standard methods to local requirements
	When	November 25-29, 2013 and June 16-20 & July 19-22, 2014
	By who	Intertek Testing Services (Thailand) Limited

No	3
Indicator	Quality of Employment
Mitigation measure	Safe and healthy working conditions
Chosen parameter	a) Relevant health and safety precautions taken, and b) Training given to staff to develop skills
Current situation of parameter	All full-time employees have been received health and safety training, and have been participated in various training programmes and classes provided by 3rd party accredited organizations or in-house experts. 52 training courses have been performed during the current monitoring period as categorized below:
Estimation of baseline situation of parameter	Prior to the implementation of the project, no one was employed and therefore there was no health and safety precautions or training
Future target for	Employment of adequate full-time staff trained with skills to carry out their job functions in a safe manner and good working environment

Training Category	No. of Training performed
Environmental, Occupation Health & Safety and Social	34
CDM and climate change	2
Landfill gas operation	2
Purchasing	2
Human potential development	6
Corporate laws and regulations	6
Total	52

parameter		
Way of monitoring	How	Number of contracts Health and Safety procedures and records Training records
	When	During October 1, 2013 to October 31, 2014.
	By who	Bangkok Greenpower; Project owner

No	4
Indicator	Quantitative employment and income generation
Mitigation measure	N/A
Chosen parameter	Number of jobs created for the operation of the project activity
Current situation of parameter	As of October 31, 2014, there are 12 permanent employees working for the Bangkok Greenpower (the project owner) for the operation of the landfill gas energy project, plus 12 permanent staff employed by Sindicatum Sustainable Resources (Thailand), indirectly and temporarily a number of contractors engaged with the pipework. There were changes of employment during the monitoring period caused by new employment, resignation and novation due to the company re-structuring. Zenith Green Energy employment has decreased from 16 to 12 during the monitoring. Since the re-structuring, Sindicatum Carbon Capital was replaced by Sindicatum Sustainable Resources (Thailand). All 4 permanent staff from Sindicatum Carbon Capital and some permanent staffs from Zenith Green Energy and Bangkok Greenpower have been novated to Sindicatum Sustainable Resources (Thailand). Overall, there is an increase of 4 staffs during the monitoring period. All staffs are based locally and are from Thailand, part from one experienced landfill gas to energy expert/manager from the UK. In addition, Sindicatum Carbon Capital has an internship programme with 5 interns were hired on short term for development of local talents. The changes of employment during the monitoring period are described as details below; 1. Sindicatum Carbon Capital (Thailand), 4 permanent staffs novated to Sindicatum Sustainable Resources (Thailand) due to re-structuring of the affiliated companies in Thailand. Moreover, there were 5 intern staffs and 1 temp staff employed and resigned within this monitoring period. 2. Sindicatum Sustainable Resources (Thailand), 1 permanent staff resigned, 1 permanent staff employed, 4 permanent staffs novated from Bangkok Greenpower and 4 permanent staffs novated from Zenith Green Energy. 3. Bangkok Greenpower, 1 permanent staff resigned, 1 permanent staff employment and 4 permanent staffs novated to Sindicatum Sustainable Resources (Thailand). Bangkok Greenpower Employment:

Position	No. of employee
Engine Operators/ Technical Analyze	3

		CDM Coordinator	1
		Civil Supervisor	1
		Cleaner	1
		Landfill Worker	5
		Store Keeper M&E/ Landfill	1
		Total	12
	Sindicatum Sustainable Resources (Thailand) Employment:		
		Position	**No. of employee**
		Managing Director (From UK)	1
		Site Manager	1
		Accountants/ Finance	4
		Procurement	2
		Compliance Manager	1
		M&E Operation Manager	1
		Officer Manager HR & Administration	1
		Senior Landfill Engineer	1
		Total	**12**
Estimation of baseline situation of parameter	Prior to the project implementation, no people were employed for operating the project, thus the baseline number of employees is 0.		
Future target for parameter	Number of people employed for the operation of the project will be greater than 1, and temporary staff will also be employed for manual work		
Way of monitoring	How	By checking employee records, number of people employed full time and temporarily and working hours	
	When	As of October 31, 2014	
	By who	Bangkok Greenpower; Project owner	

No	5
Indicator	Technology transfer and technological self-reliance
Mitigation measure	N/A
Chosen parameter	Number of visitors from other organisations
Current situation of parameter	Currently, there have been approximately 450 people who have visited the project since project started. 239 of 450 people who have visited the project during the current monitoring period.
Estimation of baseline situation of parameter	Prior to the project implementation, there was no technology transfer, thus the baseline was that the technology was not applied commercially in Thailand
Future target for	Number of people from outside of the project owners who have visited the project to learn more about the technology and its

parameter	implementation	
Way of monitoring	How	By noting attendance of organisations and individuals who have attended a site visit and/or presentation on the project and its technology
	When	During October 1, 2013 to October 31, 2014.
	By who	Bangkok Greenpower; Project owner

Annex H. Data and Parameters not monitored

Some data and parameters stated in the GS PDD are not used (ex-ante) or monitored during the current monitoring for the reasons stated in the table below.

Table 1 Applied for ex-ante emission reduction calculation ($F_{CH4,PJ,y}$ and $BE_{CH4,SWDS,y}$)

Data / Parameter	Description
1. η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity
2. $\Phi_{default}$	Default value for the model correction factor to account for model uncertainties
3. F	Fraction of methane in the SWDS gas (volume fraction)
4. $DOC_{f,default}$	Default value for fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
5. $MCF_{default}$	Methane correction factor
6. DOC_j	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
7. k_j	Decay rate for the waste type *j*

Table 2 Data and parameters to be monitored

Data / Parameter	Description	Reason
1. $C_{H2O,t,db,n}$	Moisture content of the gaseous stream at normal conditions, in time interval *t*	This parameter is not used during the current monitoring period as the temperature of the gas stream (T_t) showed that the gaseous stream is dry
2. $P_{H2O,t,sat}$	Saturation pressure of H_2O at temperature T_t in time interval *t*	This parameter is not used during the current monitoring period as the temperature of the gas stream (T_t) showed that the gaseous stream is dry
3. $V_{t,wb}$	Volumetric flow of the gaseous stream in time interval *t* on a wet basis	This parameter is not monitored during the current monitoring period as Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) is chosen for the project activity
4. $V_{i,t,wb}$	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a wet basis	This parameter is not monitored during the current monitoring period as Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) is chosen for the project activity
5. $V_{k,t,db}$	Volumetric fraction of gas k in the gaseous stream in time interval t on a dry basis	This parameter is not monitored during the current monitoring period as Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) is chosen for the project activity
6. $V_{k,t,wb}$	Volumetric fraction of gas k in the gaseous stream in time interval t on a wet basis	This parameter is not monitored during the current monitoring period as Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) is chosen for the project activity
7. $w_{C,i,}$	Weighted average mass fraction of carbon in fuel type i in year y	This parameter is not monitored during the current monitoring period as Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) is chosen for the project activity
8. $\rho_{i,y}$	Weighted average density of fuel type i in year y	This parameter is not monitored during the current monitoring period as Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) is chosen for the project activity

Document information

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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