Monitoring report form

(Version 05.0)

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

MONITORING REPORT		
Title of the project activity	Landfill Gas Recovery and Utilization at Bukit Tagar Sanitary Landfill, Hulu Selangor in Malaysia	
UNFCCC reference number of the project activity	2467	
Version number of the monitoring report	1.0	
Completion date of the monitoring report	06/05/2015	
Monitoring period number and duration of this monitoring period	Monitoring period number: 09 Duration of monitoring period: 01/04/2014 – 31/03/2015 inclusive of both days	
Project participant(s)	KUB-Berjaya Enviro Sdn. Bhd. (KBE)	
Host Party	Malaysia	
Sectoral scope(s)	13 : Waste handling and disposal	
Selected methodology(ies)	ACM 0001, version 8 [1] Consolidated baseline and monitoring methodology for landfill gas project activities	
Selected standardized baseline(s)	Not applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	282,443 tCO_2e [2]	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	Not applicable	691,884 tCO_2e [3]

1 The ACM 0001 - *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8) is no longer valid and is not available for download in UNFCCC. The version has been replaced with Version 8.1.

[2] Ex-ante for 275 days (Apr – Dec 2014): [279,458 x (275/365)] = 210,551 tCO_2e. Ex-ante for 90 days (Jan – Mar 2015): [291,563 x (90/365)] = 71,892 tCO_2e.

3 The actual value achieved for the 7th monitoring period from 01/01/2013 – 31/08/2013 is 193,581 tCO_2e, 8th monitoring period from 01/09/2013 – 31/03/2014 is 181,676 tCO_2e and 9th monitoring period from 01/04/2014 – 31/03/2015 is 316,627 tCO_2e.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Bukit Tagar Sanitary Landfill (BTSL) is operated by KUB-Berjaya Enviro Sdn. Bhd. (KBE) and located in Hulu Selangor, Malaysia. The landfill receives municipal solid waste (MSW) from the country's capital, Kuala Lumpur and Selayang district in Selangor State.

The main objective for the Clean Development Mechanism (CDM) project is to avoid direct emissions of greenhouse gases (GHGs) from the landfill into the atmosphere through active extraction. The gas collected is destructed by high temperature enclosed flares as well as is used for power generation using Gas Engines with high efficiency.

Carbon emissions are reduced through two major activities:

Emission Reduction Aspects	How will emissions be reduced?
Landfill gas (LFG) Extraction and Destruction (Methane (CH_4) avoidance)	Instead of releasing LFG (consisting CH_4) to the atmosphere, the gas will be collected and destroyed in enclosed flares and Gas Engines
Power Generation (Fuel replacement)	Less carbon dioxide (CO_2) will be emitted by replacing electricity generated from grid power with electricity produced from LFG (considered as renewable)

LFG extraction from Advance Cell, Phase 1 and 2 Cells has continued to operate during this monitoring period.

Two high temperature enclosed flares with maximum capacity of 2,500 Nm^3/hr have continued to be in operation while a portion of the gas captured was sent to a unit of 1MW Gas Engine (Gas Engine No.1) and 2 units of 1.56MW Gas Engines (Gas Engine No.2 and No.3) to generate electricity. The electricity produced by the gas engines was exported to the grid during this monitoring period.

Relevant dates for the project activities tabulated below:

Bukit Tagar Project	Construction Start	Commissioned	Continued operation periods
First flaring system	17/06/2008	28/08/2009	Continued to operate
Second flaring system	22/01/2010	07/08/2010	Continued to operate
Third flaring system	Not commissioned	Not commissioned	Not commissioned
Gas Engine No.1	03/01/2011 (delivery to site)	01/06/2011	Continued to operate
Gas Engine No.2	06/08/2012 (Signed-off Delivery Order)	06/12/2013[4]	Continued to operate
Gas Engine No.3	06/08/2012 (Signed-off Delivery Order)	06/12/2013[5]	Continued to operate

[4] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 6th December 2013.

[5] Letter to Sustainable Energy Development Authority (SEDA) Malaysia on Notification on Initial Operation Date (IOD) Occurrence on 6th December 2013.

The 9th[th] monitoring period is from 01/04/2014 to 31/03/2015 (inclusive of both days). The total emission reductions achieved during this monitoring period is **316,627 tCO_2e.**

A.2. Location of project activity

Information	Description
Host Party(ies)	Malaysia
Region/ State/ Province, etc.	State of Selangor
City/ Town/ Community, etc.	Mukim Sg. Tinggi, District of Hulu Selangor The project location is situated approximately 5km to the west of the Bukit Tagar Interchange along the North-South Expressway and 40km from central Kuala Lumpur. The landfill is easily accessible via expressway and a dedicated Bukit Tagar Interchange has been developed for the access from the North-South Expressway. The landfill is situated in a leased agricultural land, surrounded by hectares of oil palm plantations and rubber trees.
Physical/ Geographical location	**Latitude** / **Longitude** / **Description** 3°30'168" / 101°28'428" / North 3°29'07" / 101°28'452" / South 3°29'46" / 101°28'20" / West 3°29'69" / 101°29'268" / East

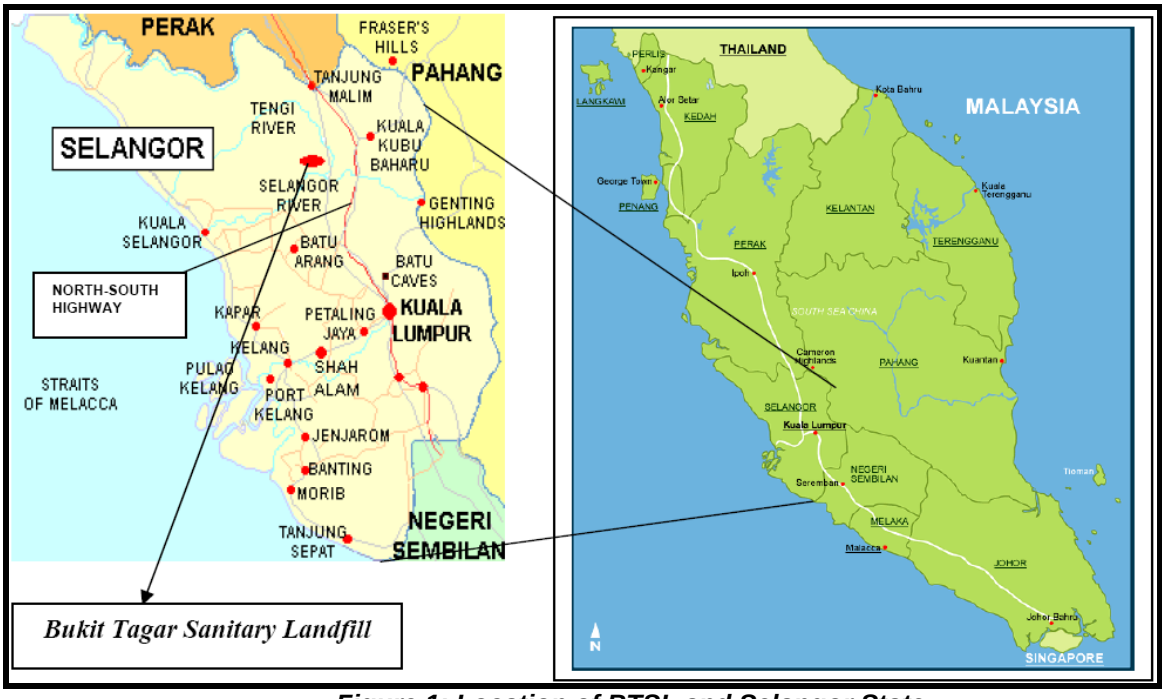


Figure 1: Location of BTSL and Selangor State

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Malaysia **(host)**	KUB-Berjaya Enviro Sdn. Bhd. (KBE) (Private)	No

Note: Japan Carbon Finance, Ltd. (JCF) (Private) was removed from this table as JCF had withdrawn on 21/10/2013 (MoC Annex 2 Withdraw Project Participant) valid as of 25/10/2013) http://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view

A.4. Reference of applied methodology and standardized baseline

The project has applied the following approved methodology and tools:

Approved Methodology:

ACM 0001 – *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8)[6]

Methodological Tools referred to include:

- *Tool for the demonstration and assessment of additionality* (Version 5.2, EB 39, Annex 10);
- *Tool to determine project emissions from flaring gases containing methane* (Version 1, EB 28, Annex 13);
- *Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site* (Version 05, EB 55, Annex 18);
- *Tool to calculate the emission factor for an electricity system* (Version 02, EB 50, Annex 14); and
- *Tool to calculate baseline, project and/or leakage emissions from electricity consumption* (Version 1, EB 39, Annex 7)
- *Tool to determine the mass flow of a greenhouse gas in a gaseous stream* (Version 02.0.0, EB 61, Annex 11).

A.5. Crediting period of project activity

The start date of the crediting period of the project activity is 28/08/2009 (date of registration) and the end date of the 1st crediting period is 27/08/2016. The selected crediting period is renewable (7 years). The 9th monitoring period is from 01/04/2014 to 31/03/2015 (inclusive of both days).

A.6. Contact information of responsible persons/entities

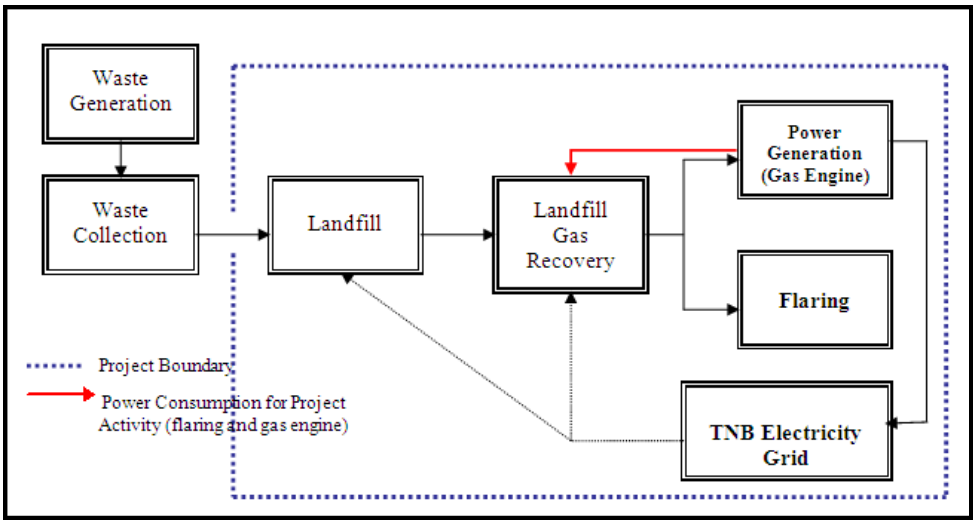
Contact person:	Mr. How Lim Sek
Designation:	Chief Operating Officer
Organisation:	KUB-Berjaya Enviro Sdn. Bhd. (KBE)
Address:	09-03 & 09-05, Level 9 East, Berjaya Times Square, No. 1 Jalan Imbi, 55100 Kuala Lumpur, Malaysia
Tel. No.:	603-2688 6333
Fax. No.:	603-2688 6332
E-mail address:	howls@kbenviro.com.my
Website:	www.kbenviro.com.my

[6] The ACM 0001 - *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8) is no longer valid and is not available for download in UNFCCC. The version has been replaced with Version 8.1.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

The landfill gas recovery, flaring and power generation system can be illustrated below:



Note:

1. *With reference to paragraph 3, Section A.2, CDM PDD version 7.2, the landfill is being developed in phases. Currently, landfill gas extraction has been implemented on 3 cells in the landfill, i.e. Advance Cell, Phase 1 and 2. These phases are included in this project as well as any future phases to be developed in accordance to the PDD.*
2. *1st Notification of change was submitted earlier to remove the on-site power consumption for landfill operation. Notification of change was approved by UNFCCC on 09/05/2012.*
3. *2nd Notification of change was submitted on 25/04/2013 to increase the power generation approximately 3MW and upload to the grid by year 2013 and installation of an additional pipeline and flare system equipped with skid mounted LFG gas blower to handle any excess LFG captured which is expected to be commissioned at the beginning of year 2014. The notification of change was approved by UNFCCC on 09/09/2013*

Figure 2: **Overall LFG Recovery, Flaring and Power Generation Design**

Description on the installed technologies

The technology applied and transferred into this project has been implemented and proven in Europe (Denmark and Germany) as well as in China (extraction and flaring system).

Detailed technical description is further described below:

Gas Extraction System in Advance Cell

Q2 Engineering Sdn. Bhd., a subsidiary of Q2 A/S of Denmark was appointed as the turnkey contractor to construct the gas extraction and flaring system for Advance Cell. 42 vertical gas extraction pipes were installed in the landfill to extract the LFG. These wells were connected to 8 units of main gas collection pipes that led to the LFG flaring system.

Figure 3: An Example of Vertical Well Installed in Advance Cell

These vertical wells can be individually regulated and controlled.

First High-Temperature Enclosed Flaring System (Flare No.1)

One unit of high-temperature enclosed flaring system had been installed to flare off the LFG extracted. The flare system included a containerised blower and flaring system with a maximum capacity to flare off 2,500 Nm^3/hr LFG.

Figure 4: Enclosed Flare Installed at Advanced Cell (Flare No.1)

The details of the flare specifications are listed below:

Specifications	Details
Manufacturer	Fairyland Environmental Technology, China
Gas flow	Maximum – 2,500 Nm^3/hr
Retention time	>0.3 seconds at 800-1,000^oC
Gas blower	Twin-lobe roots blower
Gas analysers	Gas analysers for CH_4 and O_2

Gas Extraction System in Phase 1 Cell

Stage 1 of Phase 1 Cell was completed in August 2010. The cell is still an operational cell which will be filled according to the proposed plan of the landfill sequence at a later stage. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the entire Phase 1 Cell.

Figure 5: Horizontal Gas Extraction Wells in Phase 1 Cell

Second High-Temperature Enclosed Flaring System (Flare No.2)

The second unit of high-temperature enclosed flaring system was installed to cater for the extra LFG extracted from Phase 1 Cell. The flare system included a containerised blower and flaring system with a maximum capacity to flare off 2,500 Nm^3/hr LFG.

Figure 6: High-Temperature Enclosed Flares

The flare was supplied by the same manufacturer for Flare No.1. Details of the flare specifications are listed below:

Specifications	Details
Manufacturer	Fairyland Environmental Technology, China
Gas flow	Maximum – 2,500 Nm^3/hr
Retention time	>0.3 seconds at 800-1,000^oC
Gas blower	Twin-lobe roots blower
Gas analysers	Gas analysers for CH_4 and O_2

The analyser and data logging system is similar to Flare No.1 (as described above).

Gas Extraction System in Phase 2 Cell

Phase 2A Cell was completed in October 2012. 12 lines of horizontal wells with gas pipeline were installed in the landfill to extract the LFG. The cell is still an operational cell which will be filled according to the proposed plan of the landfill sequence at a later stage. The design of the gas extraction wells is based on a series of horizontal gas extraction wells constructed over the cell.

Third High-Temperature Enclosed Flaring System (Flare No.3)

Due to the delayed landfill gas extraction in Phase 2B Cell, there is no significant amount of excess LFG captured. Therefore, Flare No.3 was delayed and will be commissioned at a later stage.

Gas Analyser and Data Logging

Monitoring of the correct functioning of the flare system was provided by a continuous-logging system which examines the operational parameters of the flare. The gas analyzing system is a multi-functional environmental monitoring equipment that can monitor up to 14 different measurements and data logging channels. Data from the logging system was presented on a local screen (on-line data) and stored in a local personal computer (PC) unit with external communication via Global System for Mobile Communications (GSM).

Data were downloaded directly from the built-in data logger to a PC and were also transmitted to external server and PC as back-up.

Gas Engine Energy Power Plants

A high-efficiency (electrical efficiency > 42%) Gas Engine (net dispatch of 1 MW) was chosen for the generation of electricity from LFG.

Figure 7: High-Efficiency Landfill Gas Engine Used in BTSL

The details of Gas Engine No.1 specifications are listed below:

Specifications	Details
Manufacturer (Origin)	MWM (Germany)
Model	TCG 2020V12
Electric power output (net to grid)	1 MW (total max. gross output 1.2 MW)
Voltage	11 kV
Frequency	50 Hz
Minimum heating value (LHV)	5.9 kWh/m^3

To ensure that good quality LFG arrives at Gas Engine No.1, a LFG pre-treatment system comprising of a chiller (made in Germany) and activated carbon filter was also set up to remove moisture and impurities such as hydrogen sulphide (H_2S) and siloxanes before Gas Engine No.1.

A landfill gas blower was installed to ensure that the required gas pressure for Gas Engine No.1 is maintained.

With the additional gas extraction of LFG in Phase 2A, 2 units of 1.56 MW gas engines were delivered to the site on 06/08/2012. The gas engines were commissioned on 06/12/2013 and the monitoring parameters for the consumption of landfill gas and additional power generated from the new gas engines were recorded and included in this Monitoring Report.

The details of Gas Engine No.2 and Gas Engine No.3 specifications (identical gas engines) are as listed below:

Specifications	Details
Manufacturer (Origin)	MWM (Germany)
Model	TCG 2020 V16
Electric power output	1.56 MW
Voltage	415 V
Frequency	50 Hz
Minimum heating value (LHV)	5.0 kwh/m3

In addition to the new gas engines installation, an additional pipeline equipped with skid mounted LFG gas blower was installed in September 2012.

Centralised SCADA System

The Centralized (Supervisory Control and Data Acquisition) SCADA Interface was developed to integrate all existing SCADA or operation monitor system, ranging from individual Flare to Gas Engines. The objective of the integrated monitoring system is aimed to improve the efficiency of staff movement, monitoring process and data collection as well as serving as additional storage of database. The new system offered remote monitoring option which allows access through internet connection for view-only if provided with the correct authentication key.

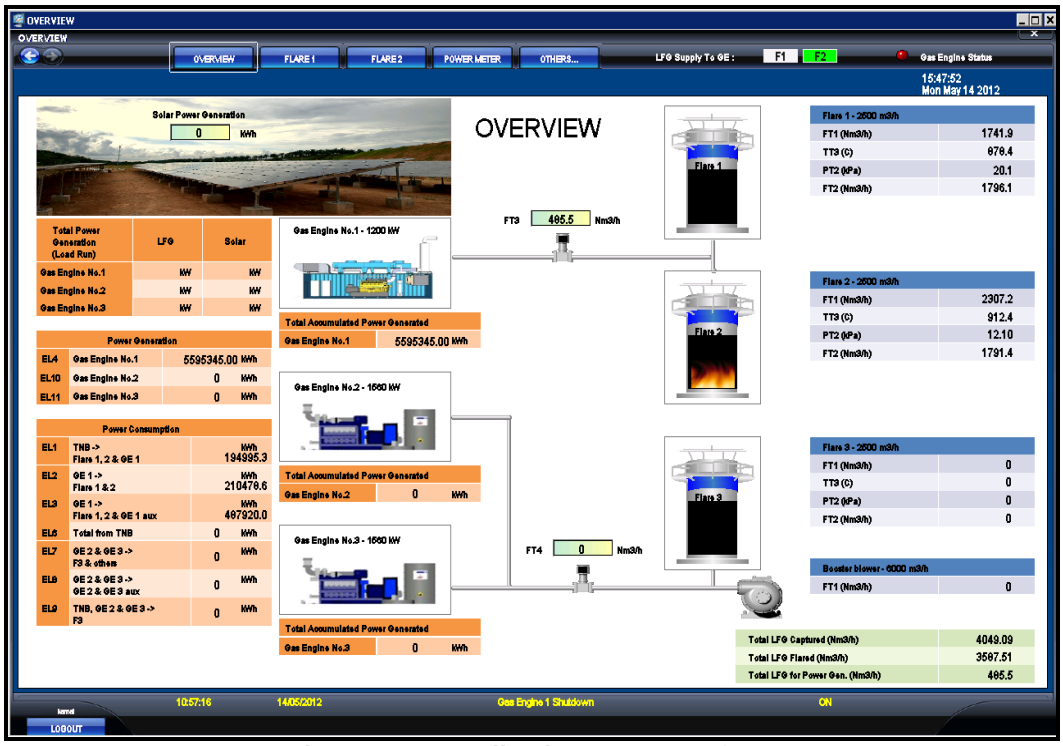


Figure 8: Centralized SCADA Interface

Implementation status of project activity

For the reporting period of 01/04/2014 to 31/03/2015, the key CDM activities implemented are described below:

Gas Extraction System in Advance Cell and Flare No.1

The actual implementation of the flaring system was initiated in August 2009 and has continued through this monitoring period.

The details on the downtime of the system (over the monitoring period covered by this report) are presented in **Appendix 1**.

The total running time for Flare No.1 is 89% during this monitoring period.

Gas Extraction System in Phase 1 and 2A Cells and Flare No.2

The flaring system in Phase 1 Cell was completed during the 2nd monitoring period and has started its operation on 07/08/2010 during the 6th monitoring period. Flare No.2 was located next to Flare No.1 where most of the LFG extracted from Phase 1 and 2A Cells is transferred via a transfer pipe and fed to Flare No.2.

The details on the downtime of the system (over the monitoring period covered by this report) are presented in **Appendix 2**.

The total running time for Flare No.2 is 99% during this monitoring period.

Power Generation

During this monitoring period, power generated from Gas Engine No.1 continued to be uploaded to the grid.

Currently, the data recording for the amount of gas channelled to Gas Engine No.1 is linked with the Flare No.2 SCADA system. Hence, the shutdown of Flare No.2 also indicated the shutdown of Gas Engine No.1.

The supply of landfill gas for Gas Engine No.1 is linked with Flare No.2.

The Gas Engine No.2 and No.3 were commissioned during the 8th monitoring period, i.e. on 06/12/2013 and have started their operations. The supply of landfill gas for Gas Engine No.2 and No.3 comes from an independent piping system and will pass through the Gas Supply System (GSS) which is the location where the properties of the landfill gas will be monitored by independent monitoring equipment, i.e. temperature, pressure, methane content and flow rate. The GSS is then connected to the 2 gas engines where power generation takes place and the power generated will be uploaded to the grid.

The details on the downtime of the Gas Engine No.1, No.2 and No.3 are presented in **Appendix 3**.

B.2. Post-registration changes

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

There were temporary deviations from registered monitoring plan or applied methodology during 8th monitoring period.

During 8th monitoring period, the Gas Engine No.2 and No.3 were operating from 06/12/2013 – 31/03/2014 and the power meter used to measure the electricity consumed by the project from grid, i.e. EL6 was not connected to the project and hence, there was no readings captured for EL6. Instead, estimation for the power consumed by Gas Engine No.2 & 3 auxiliaries and GSS was calculated using the power ratings of the equipment in the auxiliaries systems for the period of 06/12/2013 to 31/03/2014. According to paragraph 2 (3), Appendix 1 of the *CDM Project Standard*, version 09.0, if project participants have temporarily not monitored parameters related to project GHG emissions or are unable to produce evidence related to such monitoring, prior approval by the Board is not required if project participants estimate these parameters assuming that the source of the GHG emissions operated at maximum capacity for the full period of the missing data. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses. The estimation has taken into account this requirement and the calculations were shown in the CER calculation sheet under the 'Est EL6' tab.

B.2.2. Corrections

No corrections during this monitoring period.

B.2.3 Changes to start date of crediting period

No changes to start date of crediting period during this monitoring period.

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

No inclusion of a monitoring plan to the registered PDD that was not included at registration.

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

No permanent changes from registered monitoring plan or applied methodology during this monitoring period.

During the 3rd monitoring period, the revision of monitoring plan was submitted to UNFCCC and approved on 09/05/2012[7].

The revision is related to alternative measurement and handling of data during emergency conditions for methane content, flow meters and electricity meter.

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

There is no change to project design of registered project activity during this monitoring period.

During the 3rd monitoring period, the notification of change request was submitted to UNFCCC and approved on 09/05/2012[8].

The change is related to the internal use of power generated for the landfill operation which was not successful and was not approved by the relevant authorities and the grid operator. This was due to the technical constraints and removal of on-site utilization from the PDD.

During the 5th monitoring period, the 2nd notification of change request (PRC-2467-001) was submitted to UNFCCC on 25/04/2013 and was approved by UNFCCC on 09/09/2013.

The change is related to the following:

- Increase of power generation approximately 3MW and upload to the grid by year 2013
- Installation of an additional pipeline and flare system equipped with skid mounted LFG gas blower to handle any excess LFG captured which is expected to be commissioned at the beginning of year 2014

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

Not applicable.

SECTION C. Description of monitoring system

Monitoring Methodology

The basis of the monitoring plan (MP) was formulated based on the approved methodology ACM 0001 – *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8).

[7] http://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view

[8] http://cdm.unfccc.int/Projects/DB/DNV-CUK1238680609.1/view

Tool to determine project emissions from flaring gases containing methane

According to page 10 of the *Tool to determine project emissions from flaring gases containing methane*, in case of enclosed flares and use of the default value for the flare efficiency, the flare efficiency in the hour *h* ($\eta_{flare,h}$) is:

- 0%, if the temperature in the exhaust gas of the flare (T_{flare}) is below 500°C for more than 20 minutes during the hour *h*
- 50%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h* but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour *h*
- 90%, if the temperature in the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h* and the manufacturer's specifications on proper operation of the flare are met continuously during the hour *h*

The manufacturer's specification on proper operation of the flare need to be met in order to apply 90% flare efficiency in the hour *h* whenever the exhaust gas of the flare (T_{flare}) is above 500°C for more than 40 minutes during the hour *h*.

The manufacturer's specification on proper operation of the flare is monitored through the operating set point for the flare which was pre-set at the SCADA system. Whenever there is an issue where the flare operates below or above the set point; the system will be automatically shut down.

Tool to determine the mass flow of a greenhouse gas in a gaseous stream

The MP also referred to the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*.

Referring to the tools, for LFG temperatures below 60 ^{o}C, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis are not important (as reflected in the amendments to ACM 0001, version 9.1 onwards). In case where the LFG temperature exceeds 60^{o}C, the same basis for both CH_4 concentration and flow measurement will be considered according to the tools.

The detailed description on the calculation applied to the CER Calculation Sheet is as shown in **Appendix 4**.

Transmission and Distribution Losses (TDL_y)

According to page 33 of the revised registered PDD, version 9.0, the Transmission and Distribution Losses (TDL_y) value applied in this project is 10%. This value was reported in the Tenaga Nasional Berhad (TNB)[9] Annual Report 2007[10] in page 23.

[9] Tenaga Nasional Berhad is the largest electricity provider in Malaysia and is responsible for the grid transmission and distribution in Peninsular Malaysia.

[10] http://announcements.bursamalaysia.com/EDMS/subweb.nsf/7f04516f8098680348256c6f0017a6bf/303144432ec5170e482573af00388df6/$FILE/TENAGA-Cover%20to%20Page%2050%20(2.3MB).pdf

Operation and Management Structure for Monitoring

The organization structure for the Bukit Tagar CDM monitoring team is shown below:

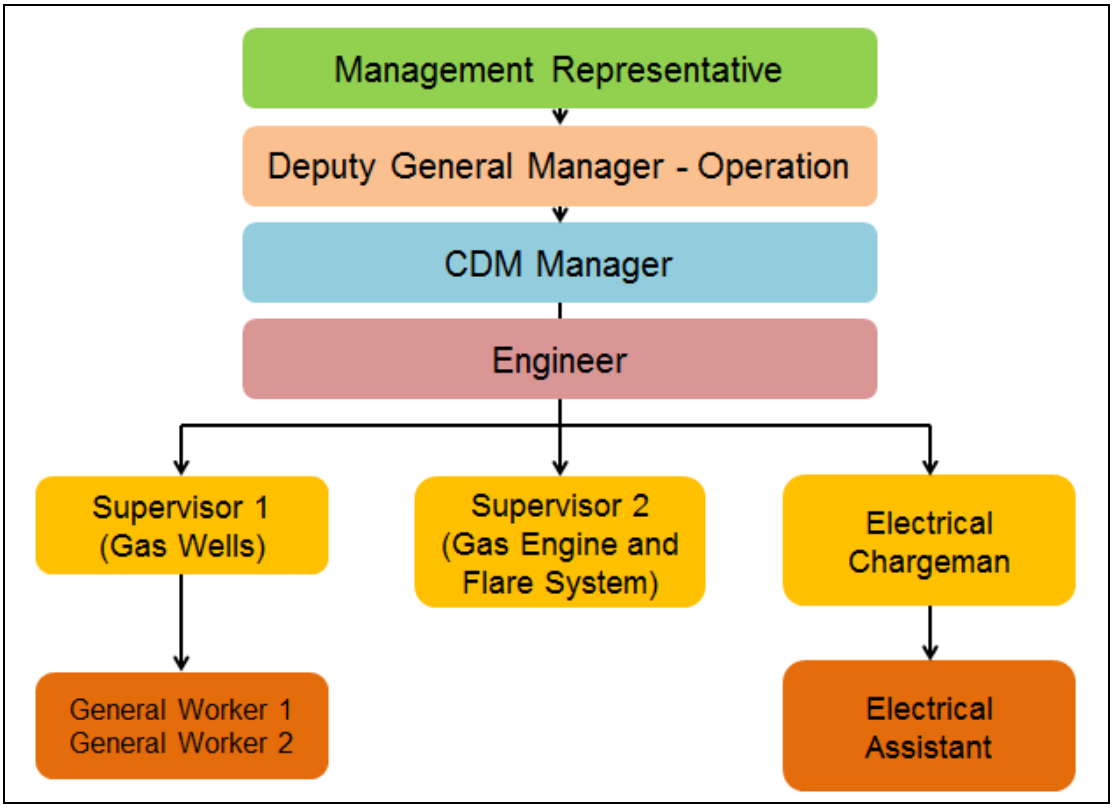


Figure 9: Organisational Structure for CDM Monitoring for BTSL LFG Recovery and Utilisation Project

The roles and responsibilities of the monitoring team in carrying out the MP are detailed as follow:

Table 1: Responsibilities of the CDM Monitoring Team

Role	Responsibility in CDM monitoring
Management Representative	• Reports to and obtain decisions from management on CDM-related matters • Chairs internal meetings on CDM matters • Signs off official correspondence for external parties
Deputy General Manager - Operation	• Reports to the management representative (MR) • Oversees entire operation of landfills (including LFG management system) • Covers responsibility of CDM Manager when he is not available
CDM Manager	• Reports to the Deputy General Manager - Operation • Oversees and coordinates the entire CDM monitoring plan • Verifies and signs off all relevant monitoring records • Ensures Quality Control / Quality Assurance (QC/QA) is carried out • Ensures all data are recorded and necessary documentations are prepared according to the requirements of CDM monitoring • Responsible in optimising the LFG extraction and utilisation system
Engineer	• Reports to the CDM Manager • Assists the CDM Manager in performing CDM monitoring works • To monitor daily operation for landfill gas operations • To assist in daily monitoring records for all CDM related equipment • To prepare daily summary record for landfill gas operation

Role	Responsibility in CDM monitoring
CDM Consultant	• Provides advice on all CDM-related matters • Prepares monitoring reports for verifications • Liaises with the verifier on verification process • Conducts regular audits on CDM monitoring
Supervisors	• Report to the CDM Manager on CDM monitoring issues • Check and ensure that the flaring system is functional • Ensure all data recording devices are functioning and calibrated as planned (including performing QA/QC) • Check and sign the daily monitoring log sheets for CDM monitoring • Supervise general workers in maintenance work and record monitored parameters for CDM monitoring • Identify maintenance requirement and contact the supplier if maintenance and support are needed • Optimise the flare operation together with the CDM Manager • Responsible with the security of locked Programmable Logic Controller (PLC) control room. The supervisor will hold the door key for the PLC control room
General Workers	• Perform regular operational and maintenance tasks • Record necessary readings in daily monitoring log sheets and request verification from the supervisors on the log sheets • Report any fault to supervisor-in-charge or the electrical chargeman

The team is overall headed by the MR who oversees the entire CDM monitoring implementation. The MR receives direct updates and support from the site staff headed by the Deputy General Manager - Operation. The Deputy General Manager – Operation is supported by the CDM Manager who is the key coordinator to all CDM monitoring matters on-site. The CDM Manager is assisted by an engineer, a group of technicians and workers who will perform the daily recording and checking tasks.

The CDM Consultant (Eco-Ideal Consulting Sdn. Bhd.) was appointed to assist KBE in ensuring that the monitoring plan and requirements were done according to the MP. The consultant played the role of a trainer and conducted independent audits as part of the QA/QC procedures set up for this project.

During this monitoring period, one CDM Management Meeting was held on 23/01/2015.

Relevant Monitoring Points

The parameters monitored during the monitoring period are illustrated in the following figure:

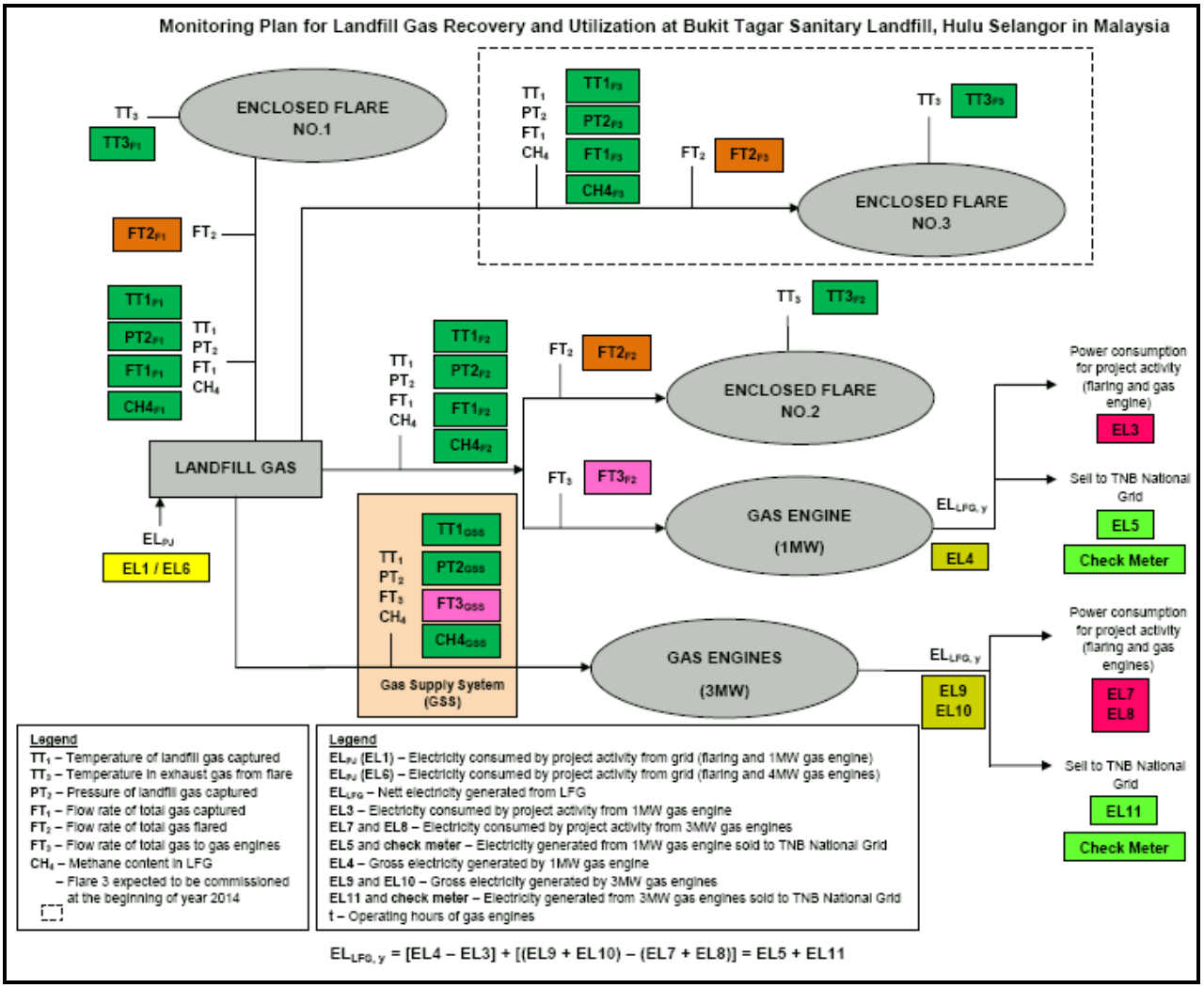


Figure 10: Key Parameters Monitored under the CDM Monitoring Plan

Remarks:
The power meter used to measure the electricity consumed by Flare No.1 and Flare No.2 from the grid was no longer in use effective from 22/06/2011. The total power consumption by the project activity from the grid (flaring systems and Gas Engine No.1) was measured by the new power meter installed, i.e. EL1. Starting from 14/06/2014, data recording was replaced with EL6 and thus, power consumption by project activity from the grid (flaring systems, Gas Engine No.1, No.2 and No.3) was recorded by EL6.

Flare No. 3 will be implemented at a later stage and as a result, no data and instrument is available, i.e. $TT1_{F3}$, $PT2_{F3}$, $FT1_{F3}$, $FT2_{F3}$, $CH4_{F3}$, and $TT3_{F3}$.

A physical connection has been installed to allow the transfer of gas from Phase 1 Cell to Flare No.1. When Flare No.2 is unable to operate, the gas from Phase 1 Cell will be channelled to Flare No.1 to be flared. A part of the gas will also be transferred to the gen-set for electricity production if required. Necessary monitoring is carried out to ensure compliance with the MP.

Data Recording and Documentation

All relevant data/measurements of the parameters taken were recorded and kept in an appropriate format and archived after the crediting period to ensure that the data are accessible especially during the monitoring and verification process of the project.

Data was recorded in the following way:

Continuous Monitoring – Data in Softcopy:
Data logger (automatic recording in computer)

Manual Recording – Data in Hardcopy:
Daily monitoring log sheets and record books (manual recording)

Based on the MP, key parameters (temperature, pressure, flow of gas, CH_4 concentration in biogas) were continuously monitored and recorded via the data logger at the control room.

As a back-up data recording system, the on-site workers were required to manually record certain monitored parameters in daily monitoring log sheets. These records were filed and kept in the office which can be accessible by the CDM Manager and technicians whenever necessary. These log sheets (in hard copies) were scanned for electronic filing on a monthly basis.

A summary of the data directly monitored is tabulated below:

Table 2: CDM Monitoring Parameters, Frequency and Archiving

Parameter	CDM ID	Equipment ID	Monitoring equipment	Recording frequency	Document ations	Data archive
Temperature	$T_{TT1,F1}$ $T_{TT1,F2}$ $T_{TT1,GSS}$	$TT_{1,Flare}$ No.1/Flare No.2/GSS	Thermocouple	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Flare Temperature	$T_{Flare,F1}$ $T_{Flare,F2}$	$TT_{3,Flare}$ No.1/Flare No.2	Thermocouple	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Pressure	$P_{PT2,F1}$ $P_{PT2,F2}$ $P_{PT2,GSS}$	$PT_{2,Flare}$ No.1/Flare No.2/GSS	Pressure Gauge	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Flowrate	$LFG_{total,Flare\ No.1/Flare\ No.2,y}$ $LFG_{flare,Flare\ No.1/Flare}$	$FT_{1,Flare}$ No.1/Flare No.2 $FT_{2,Flare}$ No.1/Flare No.2	V-Cone Differential Pressure Flowmeter	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving

Parameter	CDM ID	Equipment ID	Monitoring equipment	Recording frequency	Document ations	Data archive
	No.2,y $LFG_{electricity,Flare\ No.2/GSS,y}$	$FT_{3,Flare\ No.2/GSS}$				
Methane Fraction	$W_{CH4,Flare\ No.1/Flare\ No.2/GSS,y}$	$CH_{4,Flare\ No.1/\ Flare\ No.2/GSS}$	Continuous Infrared Gas Analyser	Every 1 min (auto) Daily (manual) – as back-up	Softcopy Hardcopy	(.MDB MS Access database) Daily log sheet will be scanned into PDF format for archiving
Electricity consumed by the project	$EL_{PJ,y}$ $EL_{PJ,GE,GE\ No.1\ auxiliary\ \&\ flare,y}$ $EL_{PJ,GE,GSS,y}$ $EL_{PJ,GE,GE\ No.2\ and\ No.3\ auxiliary,y}$	EL_{PJ} (EL1, EL6) $EL_{PJ,GE,GE\ No.1\ auxiliary\ \&\ flare}$ (EL3) $EL_{PJ,GE,GSS}$ (EL7) $EL_{PJ,GE,GE\ No.2\ and\ No.3\ auxiliary}$ (EL8)	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	Data recorded will be compiled into MS Excel and aggregated for monthly amount Daily log sheet will be scanned for archiving
Electricity generated by LFG	$EL_{LFG,GE\ No.1,y}$ $EL_{LFG,GE\ No.2,y}$ $EL_{LFG,GE\ No.3,y}$	$EL_{LFG,GE\ No.1}$ (EL4) $EL_{LFG,GE\ No.2}$ (EL9) $EL_{LFG,GE\ No.3}$ (EL10)	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	Data recorded will be compiled into MS Excel and aggregated for monthly amount Daily log sheet will be scanned for archiving
	$EL_{LFG,y}$	EL_{LFG} (EL5 and EL11, TNB main energy meters) TNB check energy meters	kWh meter	Daily (manual)	Softcopy (scanned copy) Hardcopy	TNB joint meter reading certificate will be scanned for archiving

NOTE:

Data recorded by the flow meters were normalised to Nm^3 with the temperature and pressure monitored automatically via the software. Thus, there was no need to normalise the recorded flow further. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Monitoring Equipment and Equipment Calibration

The list of CDM monitoring equipment used is shown in Table 3 & Table 4 below:

Table 3: List of CDM Monitoring Equipment and Calibration for Flare No.1

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration	Recommended Frequency
Flare System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,Flare\ No.1}$	$T_{TT1,F1}$	°C	PR Electronics	5335A	100944768	≤ ± 0.05% of span	0-100°C	10/12/2013 & CTT 1354-13 (01/04/2014 - 19/11/2014)	09/12/2014	Annually
											20/11/2014 & CTP 1256-14 (20/11/2014 - 31/03/2015)	19/11/2015	Annually
2	Temperature Transmitter	Flare Temperature ($T_{flare,y}$)	$TT_{3,Flare\ No.1}$	$T_{flare,F1}$	°C	PR Electronics	5335A	110910943	≤ ± 0.05% of span	0-1200°C	19/07/2013 & CTT 1260-13 (01/04/2014 - 28/04/2014)	18/07/2014	Annually
											29/04/2014 & CTP 1065-14 (29/04/2014 - 31/03/2015)	28/04/2015	Annually
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,Flare\ No.1}$	$P_{PT2,F1}$	kPa	Rosemount	3051TG1A2B21A B4E5M5Q4	02492864	±0.25%	0-2 to 0-207 kPa	10/12/2013 & CTP 1523-13 (01/04/2014 - 19/11/2014)	09/12/2014	Annually
											20/11/2014 & CTP 1756-14 (20/11/2014 - 31/03/2015)	19/11/2015	Annually
4	Flow Meter	Total Biogas Flow Rate ($LFG_{total,y}$)	$FT_{1,Flare\ No.1}$	$LFG_{total,Flare\ No.1}$	NM^3/hr	Flow transmitter - Rosemount Differential Pressure Transmitter - Kingways Control Vcone	3051 / KVS10IIKC23FS N	4372946 / FT119 (8102101)	±1%	3-5000Nm^3/h	25/04/2013 & CTP 1139-13 (01/04/2014 - 31/03/2015)	24/04/2015	24 months
5	Flow Meter	Flaring Biogas Flow Rate ($LFG_{flare,y}$)	$FT_{2,Flare\ No.1}$	$LFG_{flare,Flare\ No.1}$	NM^3/hr	Flow transmitter - Rosemount Differential Pressure Transmitter - Kingways	3051 / KVS10IIKC23FS N	02768008 / FT120 (8102102)	±1%	3-5000Nm^3/h	21/12/2012 & SB 121096 (01/04/2014 - 19/11/2014)	20/12/2014	24 months
											20/11/2014 & CTP 1755-14 (20/11/2014 - 31/03/2015)	19/11/2016	24 months
Gas Analysers													
6	CH_4 Meter	Methane fraction of LFG	$CH_{4,Flare\ No.1}$	$W_{CH4,Flare\ No.1,y}$	%	Guardian Plus	97460	32560	±2% of full scale	0-100%	14/03/2013 & E-1353/0413 (01/04/2014 - 28/04/2014)	13/03/2014	Annually
											29/04/2014 & CTM 1106-14 (29/04/2014 - 31/03/2015)	28/04/2015	Annually

Span Gas			
No	Parameters	Analysis date	Best if used by
1	N_2, CH_4	01/08/2011	01/08/2021
2	N_2, O_2	26/10/2009	26/10/2019
		09/01/2012	09/01/2022

Table 4: List of CDM Monitoring Equipment and Calibration for Flare No.2

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration	Recommended Frequency
Flare System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,Flare\ No.2}$	$T_{TT1,F2}$	°C	Honeywell	STT25M-0-EN0-000-000-000-00-3D	B839917437	±0.5% of span	0-100°C	25/04/2013 & CTT 1171-13 (01/04/2014 - 28/04/2014)	24/04/2014	Annually
											29/04/2014 & CTP 1063-14 (29/04/2014 - 31/03/2015)	28/04/2015	Annually
2	Temperature Transmitter	Flare Temperature ($T_{flare,y}$)	$TT_{3,Flare\ No.2}$	$T_{flare,F2}$	°C	Honeywell	STT25M-0-EN0-000-000-000-00-3D	B838901937	±0.5% of span	0-1200°C	25/04/2013 & CTT 1172-13 (01/04/2014 - 28/04/2014)	24/04/2014	Annually
											29/04/2014 & CTP 1064-14 (29/04/2014 - 31/03/2015)	28/04/2015	Annually
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,Flare\ No.2}$	$P_{PT2,F2}$	kPa	Rosemount	3051TG1A2B21AB4 E5Q4	5584784	±0.25%	0-2 to 0-207 kPa	25/04/2013 & CTP 1134-13 (01/04/2014 - 28/04/2014)	24/04/2014	Annually
											29/04/2014 & CTP 1088-14 (29/04/2014 - 31/03/2015)	28/04/2015	Annually
4	Flow Meter	Total Biogas Flow Rate ($LFG_{total,y}$)	$FT_{1,Flare\ No.2}$	$LFG_{total,Flare\ No.2}$	NM^3/hr	Flow transmitter - Rosemount Differential Pressure Transmitter - Kingways Control Vcone	3051CD1A22A1AM5 K5Q4 / KVS10IIKC23FSN	5476626 / FT141 (10031702)	±0.5%	3-5000Nm^3/h	25/04/2013 & CTP 1136-13 (01/04/2014 - 31/03/2015)	24/04/2014	24 months
5	Flow Meter	Flaring Biogas Flow Rate ($LFG_{flare,y}$)	$FT_{2,Flare\ No.2}$	$LFG_{flare,Flare\ No.2}$	NM^3/hr	Flow transmitter - Rosemount Differential Pressure Transmitter - Kingways Control Vcone	3051CD1A22A1AM5 K5Q4 / KVS10IIKC23FSN	5476627 / FT140 (10031701)	±0.5%	3-5000Nm^3/h	25/04/2013 & CTP 1137-13 (01/04/2014 - 31/03/2015)	24/04/2014	24 months
6	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,Flare\ No.2}$	$LFG_{electricity,Flare\ No.2,y}$	NM^3/hr	Flow transmitter - Rosemount Differential Pressure Transmitter - Kingways	3051CD1A22A1AM5 B4K5Q4 / KVS08IIKC23FSN	02768007 / FT161 (11011001)	±0.5%	200-2000Nm^3/h	04/10/2012 & 80424527 (PO) (01/04/2014 - 19/11/2014)	03/10/2014	24 months
											20/11/2014 & CTP 1754-14 (20/11/2014 - 31/03/2015)	19/11/2016	24 months

Gas Analysers													
7	CH_4 Meter	Methane fraction of LFG	$CH_{4,Flare\ No.2}$	$W_{CH4,Flare\ No.2,y}$	%	Guardian Plus	97460	31453	±2% of full scale	0-100%	10/12/2013 & CTP 1524-13 (01/04/2014 - 19/11/2014)	09/12/2014	Annually
											20/11/2014 & CTM 1347-14 (20/11/2014 - 31/03/2015)	19/11/2015	Annually
Power Generation and Electricity Consumption													
8	Power meter	Electricity consumed (from grid for flaring system & GE)	$EL_{F,y}$ (EL1)	$EL_{F,y}$	kWh	IME	NEMO 96HD+ (MF96021)	2167 8900 35	Class 0.5S (±0.5%)	0-400/5A	10/05/2011 & 2167 8900 35 (01/04/2014 - 14/06/2014)	09/05/2014	36 months
											03/10/2014 & SP/RA/2014/505/001-002	02/10/2017	36 months
9	Power meter	Electricity consumed (from GE for Flare 1, Flare 2 & GE auxiliaries)	$EL_{FL,GE\ No.1\ auxiliary\ \&\ flare}$ (EL3)	$EL_{FL,GE\ No.1\ auxiliary\ \&\ flare,y}$	kWh	IME	NEMO 96HD+ (MF96021)	2175 4100 36	Class 0.5S (±0.5%)	0-500/5A	21/06/2012 & 2175 4100 36 (01/04/2014 - 31/03/2015)	20/06/2015	36 months
10	Power meter	Total electricity generation (MWh) recorded by project site	$EL_{PG,GE\ No.1}$ (EL4)	$EL_{PG,GE\ No.1,y}$	kWh (to be converted to MWh)	EDMI Limited	Mk6E	210225256	Class 0.5S	99999999.99kWh	23/07/2012 & SP/RA/2012/314/001-001 (01/04/2014 - 02/10/2014)	22/07/2014	24 months
											03/10/2014 & SP/RA/2014/505/002 (03/10/2014 - 31/03/2015)	02/10/2016	24 months
11	Power meter	Electricity sell to grid (MWh) - recorded by grid operator	EL_{PG} (EL5)	$EL_{PG,y}$	kWh	Itron	SL761A071	53099690	Class 0.20	999999999kWh	01/04/2011 & TNBM-QR-064 (01/04/2014 - 31/03/2015)	31/03/2016	5 years
12	Power meter	Electricity sell to grid (MWh) - check energy meter recorded by grid operator	-	-	kWh	Itron	SL761A071	53099691	Class 0.20	999999999kWh	01/04/2011 & TNBM-QR-064 (01/04/2014 - 31/03/2015)	31/03/2016	5 years

Span Gas			
No	Parameters	Analysis date	Best if used by
1	N_2, CH_4	04/10/2010	04/10/2020
2	N_2, CO_2	04/10/2010	04/10/2020
3	N_2, O_2	04/10/2010	04/10/2020

Table 5: List of CDM Monitoring Equipment and Calibration for GSS

No	Item	Parameters	Equipment ID	CDM Monitoring ID	Unit	Manufacturer	Model No.	Serial No.	Accuracy	Range	Last Calibration Date & Cert No.	Recommended Next Calibration	Recommended Frequency
Flare System													
1	Temperature Transmitter	Temperature (T)	$TT_{1,GSS}$	$T_{TT1,GSS}$	°C	Honeywell	STT25M-0-ENS-000-000-000-00-3H	b527143837	±1%	0-100 c	11/06/2012 & JZ4a2012-06 0464 (01/04/2014 - 08/05/2014)	10/06/2013	Annually
											09/05/2014 & CTT 1096-14 (09/05/2014 - 31/03/2015)	08/05/2015	Annually
2	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,GSS}$	$P_{PT2,GSS}$	kPa	Rosemount	3051TG1A2B21AB4 K5M5	5316057	±0.1%	0-60 kPa	13/06/2012 & NO.JD1c2012-06-0259 (01/04/2014 - 08/05/2014)	12/06/2013	Annually
											09/05/2014 & CTP 1122-14 (09/05/2014 - 31/03/2015)	08/05/2015	Annually
3	Flow Meter	Flow Rate of Total Gas to Energy ($LFG_{electricity,y}$)	$FT_{3,GSS}$	$LFG_{electricity,GSS,y}$	NM^3/hr	Rosemount	3051 CD1A22A1AM5B4D FK5	5988022	±0.5%	200-2,000 Nm^3/h	05/06/2012 & D12-491-JG-02 (01/04/2014 - 08/05/2014)	04/06/2014	24 months
											09/05/2014 & CTP 1121-14 (09/05/2014 - 31/03/2015)	08/05/2016	24 months
Gas Analysers													
4	CH_4 Meter	Methane fraction of LFG	$CH_{4,GSS}$	$W_{CH4,GSS,y}$	%	Guardian Plus	97460	34140	±2% of full scale	0-100%	08/06/2012 & NHqt2012-3527 (01/04/2014 - 08/05/2014)	07/06/2013	Annually
											09/05/2014 & CTM 1113-14 (09/05/2014 - 31/03/2015)	08/05/2015	Annually
Power Generation and Electricity Consumption													
5	Power meter	Grid for project activity	EL_{PJ} (EL6)	$EL_{PJ,y}$	kWh	IME	NEMO 96HDL	2.662E+09	Class 1 (±1%)	0-250/5A	23/07/2014 & 26613300 38	22/07/2017	36 months
6	Power meter	3MW GEs for project activity (Gas Supply System (GSS))	$EL_{PJ,GE,GSS}$ (EL7)	$EL_{PJ,GE,GSS,y}$	kWh	IME	NEMO 96HDL	2.175E+09	Class 1 (±1%)	0-250/5A	23/07/2014 & 217 53900 02 (01/04/2014 - 31/03/2015)	22/07/2017	36 months
7	Power meter	3MW GEs for project activity (3MW GEs' auxiliaries)	$EL_{PJ,GE,GE\ No.2\ and\ No.3\ auxiliary}$ (EL8)	$EL_{PJ,GE,GE\ No.2\ and\ No.3\ auxiliary,y}$	kWh	Schneider Electric	DM6000	CD3412093 0959	1.0 % of reading (current and voltage)	415V/5A	23/03/2010 & 20100323-E243124 (01/04/2014 - 21/12/2014)	22/03/2012	2 years
											22/12/2014 & SP/RA/2014/651/001-001 (22/12/2014 - 31/03/2015)	21/12/2016	2 years
8	Power meter	Gross generation from GE No.2	$EL_{LFG,GE\ No.2}$ (EL9)	$EL_{LFG,GE\ No.2,y}$	kWh (to be converted to MWh)	EDMI Limited	Genius	211516862	Class 0.5S	99999999.99 kWh	08/04/2013 & PP/13AM/385 (01/04/2014 - 31/03/2015)	07/04/2015	24 months
9	Power meter	Gross generation from GE No.3	$EL_{LFG,GE\ No.3}$ (EL10)	$EL_{LFG,GE\ No.3,y}$	kWh (to be converted to MWh)	EDMI Limited	Genius	211516863	Class 0.5S	99999999.99 kWh	09/04/2013 & PP/13AM/386 (01/04/2014 - 31/03/2015)	08/04/2015	24 months
10	Power meter	Electricity sold to grid (MWh) - recorded by grid operator	EL_{LFG} (EL11)	$EL_{LFG,y}$	kWh	EDMI Limited	Mk6E	908705152	Class 0.5S	99,999,999k Wh	06/12/2009 & TNBM/PJ/09/076 (01/04/2014 - 31/03/2015)	05/12/2014	5 years
11	Power meter	Electricity sell to grid (MWh) - check energy meter recorded by grid operator	-	-	kWh	EDMI Limited	Mk6E	908705154	Class 0.5S	99,999,999k Wh	06/12/2009 & TNBM/PJ/09/076 (01/04/2014 - 31/03/2015)	05/12/2014	5 years

With reference to the Clean Development Mechanism Validation and Verification Standard, version 09.0, section 11.4.5, paragraph 395 (a), "Applying the maximum permissible error42 of the instrument to the

measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error", during this monitoring period, the equipment which have delay in calibration and the error of new calibration are less than the maximum permission error (MPE) are as listed below:

List of Equipment from Flare 1

1. CH4 (Guardian Plus serial number 32560) - Due to overdue calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/04/2014 - 28/04/2014 as a conservative approach

List of Equipment from Flare 2

1. EL1 (IME, serial no.: 2167 8900 35) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL1 from 10/05/2014 - 14/06/2014 as a conservative approach. Starting from 14/06/2014, EL1 meter is not used and data recording was replaced with EL6. Thus, power consumption by project activity from the grid (flaring systems, Gas Engine No.1, No.2 and No.3) was recorded by EL6
2. EL4 (EDMI Limited, serial no.: 210225256) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL4 from 23/07/2014 - 02/10/2014 as a conservative approach
3. FT3 (Rosemount, serial no.: 02768007) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to FT3 from 04/10/2014 - 19/11/2014 as a conservative approach
4. TT1 (Honeywell, serial no.: B839917437) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment calibration error was applied to TT1 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible
5. TT3 (Honeywell, serial no.: B838901937) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment calibration error was applied to TT3 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible
6. PT2 (Rosemount, serial no.: 5584784) - Due to overdue calibration, the maximum permissible error of ±0.25% which is the equipment calibration error was applied to PT2 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible

List of Equipment from GSS

1. TT1 (Honeywell, serial no.: b527143837) - Due to overdue calibration, the maximum permissible error of ±1% which is the equipment accuracy error was applied to TT1 from 01/04/2014 - 08/05/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible
2. PT2 (Rosemount, serial no.: 5916057) - Due to overdue calibration, the maximum permissible error of ±0.17% which is the equipment calibration error was applied to PT2 from 01/04/2014 - 08/05/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible
3. CH4 (Guardian Plus, serial no.: 34140) - Due to overdue calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/04/2014 - 08/05/2014 as a conservative approach
4. EL6 (IME, serial no.: 2661930098) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL6 from 01/04/2014 - 22/07/2014 as a conservative approach
5. EL7 (IME, serial no.: 2175390002) - Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL7 from 01/04/2014 - 22/07/2014 as a conservative approach

6. EL8 (Schneider Electric, serial no.: CO34120930959) - Due to overdue calibration, the maximum permissible error of ±1.0% which is the equipment accuracy error was applied to EL8 from 01/04/2014 - 21/12/2014 as a conservative approach

With reference to the Clean Development Mechanism Validation and Verification Standard, version 09.0, section 11.4.5, paragraph 397, "In cases where the results of the delayed calibration are not available, or the calibration has not been conducted at the time of verification, the DOE, prior to finalizing verification, shall request the project participants or the coordinating/managing entity to conduct the required calibration and shall determine whether the project participants or the coordinating/managing entity have calculated the emission reductions conservatively using the approach mentioned in paragraph 395 above".

During this monitoring period, there is an equipment which the calibration have not been conducted at the time of verification. The equipment is as listed below:

List of Equipment from GSS

1. EL 11 (EDMI Limited, serial no.: 908705152) - The meter is owned by the grid operator, TNB and thus, it is not within the control of the project. However, due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL11 from 06/12/2014 – 31/03/2015 as a conservative approach

Data Collection (for the whole monitoring period)

Based on the monitoring plan, key flaring parameters (temperature, pressure, flow of gas, CH_4 concentration in LFG) were continuously monitored and recorded via the data logger at the flare system control room. Continuous flaring data were logged and archived in every minute in the database file. These raw data were compiled and analysed for the calculation of Certified Emission Reductions (CERs).

As a back-up data recording system, the on-site workers have manually recorded certain monitored parameters in the Daily Monitoring Log Sheets. These records were scanned into soft copies for electronic filing on a monthly basis.

Data recorded manually (not recorded in the data logger system), i.e. electricity consumed were recorded in daily monitoring log sheets on a daily basis and compiled in Microsoft (MS) Excel format weekly.

Data Processing

The data logged were archived in .db file format and compiled.

Data recorded were further processed to yield the results required. A specific computation programme (in MS Access) was developed by the CDM Consultant to process continuously-monitored data to the required format and summary. An example of data aggregation on-site for flow rate of LFG at the main pipe is shown as follows:

Parameter: FT_1 (Flow rate of LFG at main pipe)

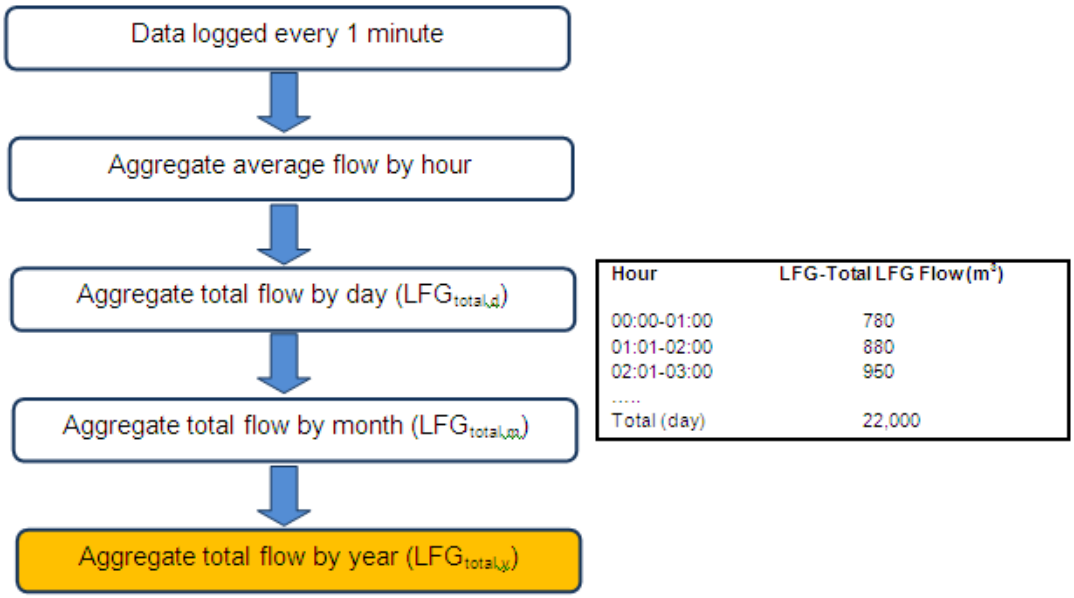


Figure 11: Example of Data Aggregation for Continuous Monitoring

Raw data logged at one (1) minute's interval were used to compute the hourly average. Subsequently, daily readings were computed, followed by aggregation into monthly and finally, yearly summaries.

Similar average values were computed for parameters such as the temperature, pressure and % CH_4.

In accordance to the *Tool to determine project emissions from flaring gases containing methane* (EB 28, Annex 13), 3 conditional default values for flare efficiency can be used for the calculation of CERs. The main criteria or condition for choosing the right default values for each hour is to assess the exhaust gas temperature from the flare stack ($T_{flare,h}$). On the other hand, all the operational parameters (temperature, pressure, etc.) related to CDM monitoring will also have to be taken into account as these parameters can affect $T_{flare,h}$. Therefore, the data of these parameters were recorded continuously through the PLC system.

Quality Assurance and Quality Control (QA & QC)

Documented Procedures and QA/QC Measures

QA/QC was applied throughout the monitoring period:

- Daily inspection of LFG extraction, flaring and monitoring systems;
- Checking and counter-signing of data forms by the CDM Manager;
- Data security (restricted access, password control) was applied to ensure the integrity of data;
- Inspection, observations, incidents and follow-up actions were documented;
- Independent audits were carried out by external consultants; and
- Data was analysed on a weekly basis to determine any irregularities.

Data Management and Storage

A proper data back-up system has been set up to ensure that the data will not be compromised in case of any unforeseen incidents at site resulting in total loss of data. The retention/archiving period for verification and CER issuance documents should be kept in electronic form for at least 2 years after the crediting period.

Continuous Monitoring (data logging system)

The data from continuous monitoring (data logger) was primarily stored in the hard disk located in the flare control room. To ensure that all data recorded are safe and properly archived, the following back-up system was applied for this project:

Types of back-up	Frequency	Back-up location
Manual back-up using a portable hard disk (HD)	Monthly	At the flare
Automatic back-up to the CDM Manager's PC located at the site office, BTSL	Weekly	On-site (site office)
Data server in the CDM Consultant's office (Eco-Ideal Consulting Sdn. Bhd., Unit C7-2, Tower C, Wisma Goshen, Bangsar Trade Centre, Kuala Lumpur, Malaysia)	Weekly	Off-site (consultant's office)

The data stored in the data server located at the CDM Consultant's office will be used as the primary back-up data in case of any emergency situation resulting in the loss of data from the flare data recording system.

The automatic data back-up system based on internet data transmission can be illustrated as follows:

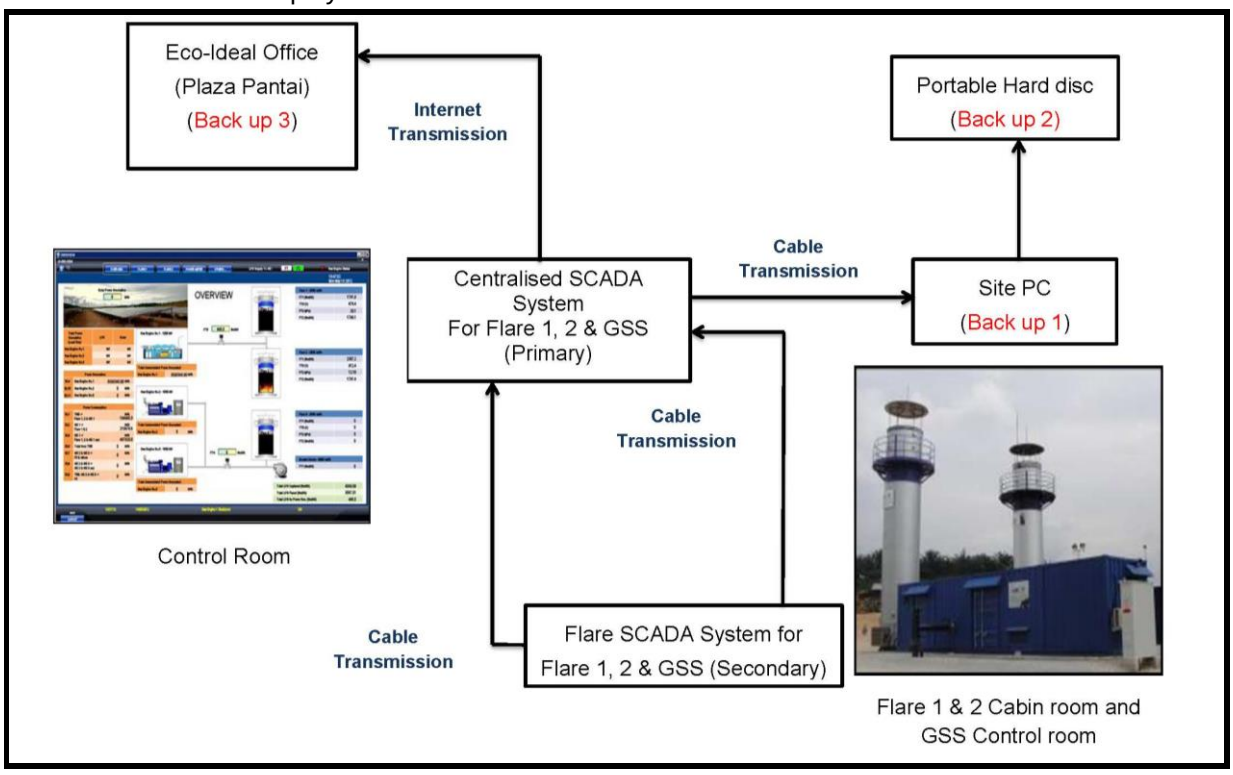


Figure 12: Automatic Data Back-Up for Flaring System at BTSL

Manual Recording

Daily operational data (consisting of CDM parameters monitored) recorded manually was backed-up by scanning all the daily monitoring log sheets on a weekly basis. These data were primarily stored in the computer at the cabin office next to the flare cabin. A copy of these scanned log sheets were handed to the CDM Consultant on a monthly basis for secondary back-up.

Independent Audits and Control Measures

All procedures for audit and QC measures were detailed in the CDM Audit Plan and Procedures. An independent audit relevant to the 9th monitoring period was conducted by the consultant (Eco-Ideal Consulting Sdn. Bhd.):

- Audit No. 12 – 09/04/2015

The independent audit served as an important QC measure to ensure that all the monitoring required are done in accordance to the plan. Through the audit, the project can pre-empt any potential problems, issues as well as identify improvement measures during the monitoring period.

Training

Training is important to ensure that all the involved staff is provided with the needed knowledge and skills to undertake their roles effectively according to the CDM MP.

During this monitoring period, training has been conducted by the CDM consultants to the site officers on 09/04/2015.

The staff has also attended several technical/operational trainings as listed below:

No.	Description	Date	No. of participants
1	Refresher Training – GDU Operation	16/05/2014	9
2	Training for LFG System – Flare 1	21/07/2014	8
3	Training for Gas Engine Pre-treatment	16/10/2014	9
4	Training for Maintenance – Flare moisture separator	15/01/2015	7

SECTION D. Data and parameters

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

Data / Parameter:	Regulatory requirement relating to landfill gas projects
Unit:	-
Description:	Regulatory requirement relating to landfill gas projects
Source of data:	There is no regulatory requirement to recover and utilize landfill gas in Malaysia. Confirmation from the Department of National Solid Waste Management of the Ministry of Housing and Local Government regarding regulation aspects of landfill gas has already been obtained at the beginning of the earliest crediting period, i.e. during the 1st monitoring period (28/08/2009 – 28/02/2010).
Value(s) applied):	NA
Choice of data or measurement methods and procedures	NA
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	GWP_{CH4}
Unit:	tCO_2e/tCH_4
Description:	Global Warming Potential (GWP) for CH_4
Source of data:	With reference to decision 4/CMP7 and paragraph 66 of the EB 69 Meeting Report, for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in Table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon, i.e. 25 tCO_2/tCH_4
Value(s) applied):	25
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	D_{CH4}
Unit:	t_{CH4}/m^3_{CH4}
Description:	CH_4 density at standard temperature and pressure
Source of data:	ACM 0001 – *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8)
Value(s) applied):	0.0007168

Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**Φ**
Unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data:	This uncertainty factor was adopted and the value is 0.9 based on recommendations in the *Tool to determine methane emissions avoided from dumping waste at solid waste disposal site*
Value(s) applied):	0.9
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	**f**
Unit:	-
Description:	Fraction of methane captured at the solid waste disposal site (SWDS) and flared, combusted or used in another manner
Source of data:	There is no methane flared, combusted or used for other purposes in the baseline scenario
Value(s) applied):	0
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

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:	Site-visit reveals that this landfill is well managed and soil cover is applied on a daily basis. Therefore, the value 0.1 was applied as recommended by *the Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site*
Value(s) applied):	0.1
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	F
Unit:	%
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data:	This value was applied based on the recommendation of the IPCC in the *Tool to determine methane emissions avoided from dumping waste at a solid waste disposal site*
Value(s) applied):	0.5
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	DOC_f
Unit:	%
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data:	This value was applied based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied):	0.5
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	MCF
Unit:	-
Description:	Methane Correction Factor
Source of data:	This value was applied based on the recommendation of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. BTSL site is a fully anaerobically-managed SWDS. The waste received at the landfill was deposited at a specific tipping phase and there was no scavenging of waste in the landfill. Wastes were covered daily with compacted soil. Compaction as well as levelling is practiced based on the international landfill operational practices
Value(s) applied):	1.0
Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	DOC_j
Unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*

<table>
<tr><td>Source of data:</td><td>The above values were adopted from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4)</td></tr>
<tr><td>Value(s) applied):</td><td>The following values for the different waste fraction (types) were applied:

<table>
<tr><th colspan="3">DOC_j</th></tr>
<tr><th>Waste type j</th><th>DOC_i (% wet basis)</th><th>DOC_i (% dry basis)</th></tr>
<tr><td>Wood and wood products</td><td>43</td><td>50</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td><td>44</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td><td>38</td></tr>
<tr><td>Textiles</td><td>24</td><td>30</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td><td>49</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td><td>0</td></tr>
<tr><td>Nappies</td><td>24</td><td>60</td></tr>
</table></td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>Default Value</td></tr>
<tr><td>Purpose of data:</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comment:</td><td>-</td></tr>
</table>

Data / Parameter:	**kj**
Unit:	-
Description:	Decay rate for the waste type *j*
Source of data:	The above values were adopted from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)

Value(s) applied):	The following values for the different waste fraction (types) were applied:

Waste type *j*		Boreal and Temperature (MAT<20°C)		Tropical (MAT>20°C)	
		Dry (MAP/PET<1)	Wet (MAP/PET>1)	Dry (MAP<1000 mm)	Wet (MAP>1000 mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0/06	0.045	**0.07**
Slowly degrading	Wood, wood products and straw	0.02	0.03	0.025	**0.035**
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.1	0.065	**0.17**
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	**0.4**

Choice of data or measurement methods and procedures	Default Value
Purpose of data:	Baseline emission calculation
Additional comment:	The project site is located in the State of Selangor, Malaysia. The climate is tropical with an annual mean 24-hr temperature of approximately 27°C and annual mean precipitation of around 2,700 mm. These values were long-term averages documented in the Environmental Impact Assessment (EIA) Report prepared for the landfill in 2005. Thus, the K-values for tropical temperature and wet climate were used

D.2. Data and parameters monitored

Data / Parameter:	$LFG_{total,y}$
Unit:	m^3
Description:	Total amount of LFG captured during the project at normal temperature and pressure
Measured/ Calculated / Default:	Measured
Source of data:	Continuous measurement by flow meter during operation of project activity. This parameter was measured continuously and separately for both of the flares and gas engines, i.e. Flare No.1 (1 meter) and Flare No.2 & Gas Engine No.1 (1 meter). Therefore, 2 sets of equipment were used for the monitoring period. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period. During temporary malfunctioning of flow meter or data logging system resulting in unrepresentative data, the value of LFG_{total} for the affected period will be taken as the sum of LFG_{flare} and $LFG_{eletricity.}$ The supply of landfill gas to the Gas Supply System (GSS) comes from an independent piping system. The properties of the landfill gas were monitored by independent monitoring equipment, i.e. temperature ($TT1_{GSS}$), pressure ($PT2_{GSS}$), methane content ($CH4_{GSS}$) and flow rate ($FT3_{GSS}$).
Value(s) of monitored parameter:	**Flare No.1** According to ACM 0001, version 8 [11], page 15 of section III monitoring methodology, the amount of landfill gas generated (in m^3 using a continuous flow meter), where the total quantity (LFG_{total}), as well as the quantities fed to the flare (s) (LFG_{flare}), to the power plant (s) ($LFG_{electricity}$) are measured continuously. In the case where LFG is just flared, one flow meter for each flare can be used provided that these meters used are calibrated periodically by an officially accredited entity; The total LFG captured was the same as the total LFG flared for Flare No.1 during the monitoring period as total LFG captured in Flare No1 was only sent to flare. **Flare No.2** According to ACM 0001, version 8, page 15 of section III monitoring methodology, the amount of landfill gas generated (in m^3 using a continuous flow meter), where the total quantity (LFG_{total}), as well as the quantities fed to the flare (s) (LFG_{flare}), to the power plant (s) ($LFG_{electricity}$) are measured continuously. In the case where LFG is just flared, one flow meter for each flare can be used provided that these meters used are calibrated periodically by an officially accredited entity. From 01/06/2011, the total LFG captured (FT1) is the summation of total LFG flared (FT2) and total LFG electricity (FT3). As a conservative approach, during normal operation, the values of FT1 will be compared with the total of FT2 and FT3 and the lower value of the FT will be used for ER calculation.

[11] The ACM0001 - *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8) is no longer valid and is not available for download in UNFCCC. The version has been replaced with Version 8.1.

For the comparison, there are 2 cases which will happen:

1. *When FT1 is greater than FT2 + FT3*

   When FT1 is greater, the total values of FT2 + FT3 will be used and presented as the value of FT1 in the ER calculation as a conservative approach.

2. *When FT1 is lower than FT2 + FT3*

   When FT1 is lower, FT1 will then be used in the ER calculation as a conservative approach.

Months	Flare No.2 FT1 Value (Nm^3)	Flare No.2 Total of FT2 & FT3 Value (Nm^3)
April 14	1,525,303	1,428,703
May 14	1,507,884	1,406,595
June 14	1,489,845	1,398,011
July 14	1,537,122	1,443,105
August 14	1,488,173	1,395,562
September 14	1,496,885	1,404,362
October 14	1,609,849	1,515,760
November 14	1,439,436	1,370,227
December 14	1,523,089	1,448,436
January 15	1,589,636	1,513,978
February 15	1,330,481	1,257,590
March 15	1,322,210	1,233,937
Total	**17,859,912**	**16,816,264**

From the monthly comparison of the FT1 & FT2 + FT3 values above, the lower value between the two is taken for the calculation of CERs.

Months	Flare No.1 Value (Nm^3)	Flare No.2 Value (Nm^3)
April 14	352,766	1,525,303
May 14	76,830	1,507,884
June 14	465,175	1,489,845
July 14	412,101	1,537,122
August 14	461,212	1,488,173
September 14	403,831	1,496,885
October 14	422,984	1,609,849
November 14	494,566	1,439,436
December 14	503,406	1,523,089
January 15	468,872	1,589,636
February 15	408,706	1,330,481
March 15	374,637	1,322,210
Total	**4,845,085**	**17,859,912**

For this monitoring period for Flare No.2, the total values of FT2 + FT3 was used

in the ER calculation since FT1 is greater than FT2 + FT3.

Months	GSS Value (Nm^3)
April 14	775,946
May 14	921,312
June 14	826,604
July 14	873,811
August 14	765,304
September 14	876,036
October 14	716,811
November 14	824,730
December 14	762,878
January 15	782,135
February 15	816,109
March 15	927,501
Total	**9,869,176**

GSS (Gas Engine No. 2 and 3)

According to ACM 0001, version 8 [12], page 15 of section III monitoring methodology, the amount of landfill gas generated (in m^3 using a continuous flow meter), where the total quantity (LFG_{total}), as well as the quantities fed to the flare (s) (LFG_{flare}), to the power plant (s) ($LFG_{electricity}$) are measured continuously. In the case where LFG is just sent to the power plants (gas engines) for electricity generation, one flow meter can be used provided that these meters used are calibrated periodically by an officially accredited entity; The total LFG captured was the same as the total LFG sent to the gas engines for GSS during the monitoring period as total LFG captured in GSS was only sent to Gas Engine No.2 and 3.

The amount of landfill gas generated which is channelled to the Gas Supply System (GSS) is measured continuously by using a flow meter and the data, as reported under the parameter **$LFG_{electricity,y}$** is as tabulated here. For more details of the parameter and the measuring instrument, please refer to the monitoring parameter **$LFG_{electricity,y}$** below.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

[12] The ACM0001 - *Consolidated baseline and monitoring methodology for landfill gas project activities* (Version 8) is no longer valid and is not available for download in UNFCCC. The version has been replaced with Version 8.1.

<table>
<tr><td>Monitoring equipment:</td><td>
<table>
<tr><th rowspan="2">Item</th><th>Flare No.1 Description</th><th>Flare No.2 Description</th></tr>
<tr><th>01/04/2014 - 31/03/2015</th><th>01/04/2014 - 31/03/2015</th></tr>
<tr><td>Type</td><td>Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone</td><td>Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone</td></tr>
<tr><td>Accuracy class</td><td>± 1%</td><td>± 0.5%</td></tr>
<tr><td>Serial No.</td><td>4972946 (Rosemount) / FT1 – FT119 (8102101) (Kingsway)</td><td>5476626 (Rosemount) / FT1 – FT141 (10031702) (Kingways)</td></tr>
<tr><td>Calibration frequency</td><td>24 months</td><td>24 months</td></tr>
<tr><td>Date of last calibration</td><td>25/04/2013</td><td>25/04/2013</td></tr>
<tr><td>Validity</td><td>24 months</td><td>24 months</td></tr>
</table>

<u>Flare No.3</u>
Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

<u>GSS (Gas Engine No. 2 and 3)</u>
The details of the monitoring parameter equipment is as shown under $LFG_{electricity,y}$ below.</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Measured continuously with a flow meter. Data was aggregated on both monthly and yearly basis</td></tr>
<tr><td>Calculation method (if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>Flow meters were tested, calibrated and maintained regularly</td></tr>
<tr><td>Purpose of data:</td><td>Baseline emission calculation</td></tr>
<tr><td>Additional comment:</td><td>-</td></tr>
</table>

Data / Parameter:	**$LFG_{flare,y}$**
Unit:	m^3
Description:	Total amount of LFG sent to flare at normal temperature and pressure
Measured/ Calculated / Default:	Measured
Source of data:	Continuous measurement by flow meter during operation of project activity. This parameter was measured separately for both of the flares, i.e. Flare No.1 and Flare No.2. Therefore, 2 sets of equipment were used for the monitoring period. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period. During temporary malfunctioning of flow meter or data logging system resulting in unrepresentative data, the value of LFG_{flare} for the affected period will be derived by subtracting $LFG_{electricity}$ from $LFG_{total.}$

Value(s) of monitored parameter:

Flare No.2

From 01/06/2011, the total LFG flared continued to be measured by FT2. As a conservative approach, during normal operation, the value of FT1 will be compared with the total of FT2 and FT3 and the lower value of the FT will be used for ER calculation.

For the comparison, there are 2 cases which will happen:

1. *When FT1 is greater than FT2 + FT3*

   The value of FT2 will be used in the ER calculation as a conservative approach.

2. *When FT1 is lower than FT2 + FT3*

   The value of FT1 will be used to calculate the proportion of FT2 by ratio (formula: FT2 value = FT2 / (FT2 + FT3) * FT1.) The calculated value of the proportion of FT2 will be used in the ER calculation as a conservative approach.

Months	Flare No.1 Value (Nm^3)	Flare No.2 Value (Nm^3)
April 14	352,766	1,163,098
May 14	76,830	1,251,637
June 14	465,175	1,167,128
July 14	412,101	1,161,002
August 14	461,212	1,190,159
September 14	403,831	1,170,549
October 14	422,984	1,219,400
November 14	494,566	1,222,301
December 14	503,406	1,230,903
January 15	468,872	1,259,471
February 15	408,706	1,067,908
March 15	374,637	1,113,616
Total	**4,845,085**	**14,217,173**

From the monthly comparison of the FT1 & FT2 + FT3 in this monitoring period, the value of FT2 was used in the ER calculation since FT1 is greater than FT2 + FT3.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Monitoring equipment:

Item	Flare No.1 Description	
	01/04/2014 - 19/11/2014	20/11/2014 - 31/03/2015
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone	
Accuracy class	± 1%	
Serial No.	02768008 (Rosemount) / FT120 (8102102) (Kingways)	
Calibration frequency	24 months	
Date of last calibration	21/12/2012	20/11/2014
Validity	24 months	

Item	Flare No.2 Description
	01/04/2014 - 31/03/2015
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone
Accuracy class	± 0.5%
Serial No.	5476627 (Rosemount) / FT2 – FT140 (10031701) (Kingways)
Calibration frequency	24 months
Date of last calibration	25/04/2013
Validity	24 months

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Measuring/ Reading/ Recording frequency:	Measured continuously with flow meter. Data was aggregated on both monthly and yearly basis
Calculation method (if applicable):	Raw data logged at 1 minute's interval were used to compute the hourly average. Subsequently, daily readings were computed, followed by aggregation into monthly and finally, yearly records
QA/QC procedures:	Flow meters were tested, calibrated and maintained regularly
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**$LFG_{electricity,y}$**
Unit:	m^3
Description:	Amount of landfill gas combusted in power plant (Gas Engine No.1, 2 and 3) at normal temperature and pressure
Measured/ Calculated / Default:	Measured

<table>
<tr><td>Source of data:</td><td>Continuous measurement by flow meter during operation of project activity.

This parameter was measured separately for the gas engines, i.e. Gas Engine No. 1 (1 meter) and Gas Engine No. 2 and No. 3 (1 meter). Therefore, 2 sets of equipment have to be used for the monitoring period.

During temporary malfunctioning of flow meter or data logging system resulting in unrepresentative data, the value of $LFG_{electricity}$ for the affected period will be derived by subtracting LFG_{flare} from LFG_{total}.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td><u>Flare No.2</u>
From 01/06/2011, the total LFG for electricity is measured by FT3. As a conservative approach, during normal operation, the value of FT1 will be compared with the total of FT2 and FT3 and the lower value of the FT will be used for ER calculation.

For the comparison, there are 2 cases which will happen:

1. <u>When FT1 is greater than FT2 + FT3</u>

The value of FT3 will be used in the ER calculation as a conservative approach

2. <u>When FT1 is lower than FT2 + FT3</u>

The value of FT1 will be used to calculate the proportion of FT3 by ratio (formula: FT3 value = FT3 / (FT2 + FT3) * FT1. The calculated value from the proportion of FT3 will be used in the ER calculation as a conservative approach.

<table>
<tr><th>Months</th><th>Flare No.2 Value (Nm^3)</th><th>GSS Value (Nm^3)</th></tr>
<tr><td>April 14</td><td>265,605</td><td>775,946</td></tr>
<tr><td>May 14</td><td>154,957</td><td>921,312</td></tr>
<tr><td>June 14</td><td>230,883</td><td>826,604</td></tr>
<tr><td>July 14</td><td>282,102</td><td>873,811</td></tr>
<tr><td>August 14</td><td>205,403</td><td>765,304</td></tr>
<tr><td>September 14</td><td>233,813</td><td>876,036</td></tr>
<tr><td>October 14</td><td>296,360</td><td>716,811</td></tr>
<tr><td>November 14</td><td>147,926</td><td>824,730</td></tr>
<tr><td>December 14</td><td>217,533</td><td>762,878</td></tr>
<tr><td>January 15</td><td>254,506</td><td>782,135</td></tr>
<tr><td>February 15</td><td>189,682</td><td>816,109</td></tr>
<tr><td>March 15</td><td>120,320</td><td>927,501</td></tr>
<tr><td>Total</td><td>2,599,091</td><td>9,869,176</td></tr>
</table>
From the monthly comparison of the FT1 & FT2 + FT3 in this monitoring period, the value of FT3 was used in the ER calculation since FT1 is greater than FT2 + FT3.</td></tr>
</table>

Monitoring equipment:

Item	Flare No.2 Description	
	01/04/2014 - 19/11/2014	20/11/2014 – 31/03/2015
Type	Flow transmitter – Rosemount Differential Pressure Transmitter – Kingways Control Vcone	
Accuracy class	± 0.5%	
Serial No.	02768007 (Rosemount) / FT161 (11011001) (Kingways)	
Calibration frequency	24 months	
Date of last calibration	04/10/2012	20/11/2014
Validity	24 months	

Item	GSS Description	
	01/04/2014 – 08/05/2014	09/05/2014 – 31/03/2015
Type	Flow transmitter – Rosemount	
Accuracy class	± 0.5%	
Serial No.	5988022	
Calibration frequency	24 months	
Date of last calibration	05/06/2012	09/05/2014
Validity	24 months	

Flare No.2
Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to FT3 from 04/10/2014 - 19/11/2014 as a conservative approach.

Measuring/ Reading/ Recording frequency:	Measured with flow meter. Data will be aggregated both monthly and yearly
Calculation method (if applicable):	Raw data logged at 1 minute's interval were used to compute the hourly average. Subsequently, daily readings were computed, followed by aggregation into monthly and finally, yearly records
QA/QC procedures:	Flow meters were tested, calibrated and maintained regularly
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**$PE_{flare,y}$**
Unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in year *y*
Measured/ Calculated / Default:	Calculated

<table>
<tr><td>Source of data:</td><td>Calculated as per the Tool to determine project emissions from flaring gases containing methane (EB 28, Annex 13, page 10).

This parameter was measured separately for both flares, i.e. Flare No.1 and Flare No.2. Therefore, 2 sets of equipment were used for the monitoring period.

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Flare No.1 Value (tCO_2e)</th><th>Flare No.2 Value (tCO_2e)</th></tr>
<tr><td>April 14</td><td>341</td><td>1,284</td></tr>
<tr><td>May 14</td><td>84</td><td>1,317</td></tr>
<tr><td>June 14</td><td>437</td><td>1,159</td></tr>
<tr><td>July 14</td><td>387</td><td>1,108</td></tr>
<tr><td>August 14</td><td>447</td><td>1,297</td></tr>
<tr><td>September 14</td><td>385</td><td>1,285</td></tr>
<tr><td>October 14</td><td>375</td><td>1,298</td></tr>
<tr><td>November 14</td><td>464</td><td>1,330</td></tr>
<tr><td>December 14</td><td>494</td><td>1,365</td></tr>
<tr><td>January 15</td><td>461</td><td>1,407</td></tr>
<tr><td>February 15</td><td>473</td><td>1,239</td></tr>
<tr><td>March 15</td><td>428</td><td>1,239</td></tr>
<tr><td>Total</td><td>4,776</td><td>15,328</td></tr>
</table>
<u>Flare No.3</u>
Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.</td></tr>
<tr><td>Monitoring equipment:</td><td>Refer to T_{flare} below</td></tr>
<tr><td>Measuring/
Reading/
Recording frequency:</td><td>As per the Tool to determine project emissions from flaring gases containing methane (EB 28, Annex 13, page 10).

As the project has installed an enclosed flaring system, the default value of 0.90 for enclosed flare efficiency for flare temperatures above 500^0C for more than 40 minutes in an hour was applied and monitored during the monitoring period. This is conservative as the enclosed flare was typically designed to operate at a much higher temperature (>900^0C).</td></tr>
<tr><td>Calculation method (if applicable):</td><td>As per the Tool to determine project emissions from flaring gases containing methane (EB 28, Annex 13, page 10)</td></tr>
<tr><td>QA/QC procedures:</td><td>As per the Tool to determine project emissions from flaring gases containing methane (EB 28, Annex 13, page 10)</td></tr>
<tr><td>Purpose of data:</td><td>Project emission calculation</td></tr>
<tr><td>Additional comment:</td><td>-</td></tr>
</table>

Data / Parameter:	**w_{CH4}**
Unit:	m^3 CH4 / m^3 LFG
Description:	Fraction of CH_4 in LFG

<table>
<tr><td>Measured/ Calculated / Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Continuous measurement by using certified equipment.

This parameter was measured separately for both flares and the gas engines, i.e. Flare No.1 (1 meter), Flare No.2 & Gas Engine No.1 (1 meter) and Gas Engine No.2 and No.3 (1 meter). Therefore, 3 sets of equipment have to be used for the monitoring period.

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

In case of temporary situation such as the installed CH_4 gas analyser malfunctioned or gave unrepresentative results due to data logging problem, the w_{CH4} shall be measured manually with a portable gas analyser according to ACM 0001 Version 8. At least 8 hourly samples shall be taken per operating day. For any affected day, the calculation of the values measured using the portable analyser will be based on the Guidelines to calculate the fraction of methane in the landfill gas from periodical measurements (Version 1). As a conservative approach, the lower bound of the 95% Confidence Interval will be applied as per the guideline.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Flare No.1 Value (%)</th><th>Flare No.2 Value (%)</th><th>GSS Value (%)</th></tr>
<tr><td>April 14</td><td>0.52</td><td>0.61</td><td>0.57</td></tr>
<tr><td>May 14</td><td>0.51</td><td>0.58</td><td>0.59</td></tr>
<tr><td>June 14</td><td>0.52</td><td>0.55</td><td>0.56</td></tr>
<tr><td>July 14</td><td>0.51</td><td>0.53</td><td>0.57</td></tr>
<tr><td>August 14</td><td>0.51</td><td>0.61</td><td>0.50</td></tr>
<tr><td>September 14</td><td>0.50</td><td>0.59</td><td>0.56</td></tr>
<tr><td>October 14</td><td>0.48</td><td>0.59</td><td>0.56</td></tr>
<tr><td>November 14</td><td>0.51</td><td>0.60</td><td>0.56</td></tr>
<tr><td>December 14</td><td>0.53</td><td>0.61</td><td>0.54</td></tr>
<tr><td>January 15</td><td>0.55</td><td>0.61</td><td>0.50</td></tr>
<tr><td>February 15</td><td>0.55</td><td>0.60</td><td>0.56</td></tr>
<tr><td>March 15</td><td>0.50</td><td>0.57</td><td>0.61</td></tr>
<tr><td>Average</td><td>0.52</td><td>0.59</td><td>0.56</td></tr>
</table>

<u>Flare No.3</u>
Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.</td></tr>
</table>

Monitoring equipment:

Item	Flare No.1 Description	
	01/04/2014 – 28/04/2014	29/04/2014 – 31/03/2015
Type	Guardian Plus (97460) Infra-Red Gas Monitor	
Accuracy class	± 2%	
Serial No.	32560	
Calibration frequency	Annually	
Date of last calibration	14/03/2013	29/04/2014
Validity	1 year	

Item	Flare No.2 Description	
	01/04/2014 – 19/11/2014	20/11/2014 – 31/03/2015
Type	Guardian Plus (97460) Infra-Red Gas Monitor	
Accuracy class	± 2%	
Serial No.	31453	
Calibration frequency	Annually	
Date of last calibration	10/12/2013	20/11/2014
Validity	1 year	

Item	GSS Description	
	01/04/2014 – 08/05/2014	09/05/2014 – 31/03/2015
Type	Guardian Plus (97460) Infra-Red Gas Monitor	
Accuracy class	± 2%	
Serial No.	34140	
Calibration frequency	Annually	
Date of last calibration	08/06/2012	09/05/2014
Validity	1 year	

Flare No.1

Due to delayed calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/04/2014 - 28/04/2014 as a conservative approach.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

GSS (Gas Engine No. 2 and 3)

Due to delayed calibration, the maximum permissible error of ±2% which is the equipment accuracy error was applied to CH4 from 01/04/2014 - 08/05/2014 as a conservative approach.

Measuring/ Reading/ Recording frequency:	The CH_4 fraction were measured continuously with certified equipment or measured manually with a portable gas analyser during emergency cases
Calculation method (if applicable):	Raw data logged at 1 minute's interval was used to compute the daily average readings
QA/QC procedures:	The CH_4 gas analyser was checked and calibrated regularly according to the manual given by the manufacturer

Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**T ($T_{TT1,F1}$,$T_{TT1,F2}$, $T_{TT1,GSS}$)**
Unit:	°C
Description:	Temperature of the LFG
Measured/ Calculated / Default:	Measured
Source of data:	Continuous measurement by temperature meter. This parameter was measured separately for both flares and the gas engines, i.e. Flare No.1 (1 meter), Flare No.2 & Gas Engine No.1 (1 meter) and Gas Engine No.2 and No.3 (1 meter). Therefore, 3 sets of equipment have to be used for the monitoring period. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Value(s) of monitored parameter:

Months	Flare No.1 Value (°C)	Flare No.2 Value (°C)	GSS Value (°C)
April 14	36.81	43.38	46.86
May 14	40.10	43.88	48.17
June 14	41.13	45.05	48.11
July 14	37.12	44.36	49.20
August 14	36.61	42.75	46.29
September 14	35.90	43.24	48.57
October 14	37.10	43.12	46.74
November 14	41.30	42.84	47.99
December 14	41.28	42.35	46.56
January 15	41.10	43.77	48.74
February 15	41.78	43.90	52.90
March 15	40.91	42.80	52.93
Average	**39.26**	**43.45**	**48.59**

Flare No.1

Referring to the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*, version 2.0, for LFG temperatures below 60^{o}C, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis is not important (as reflected in the amendments to ACM 0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60^{o}C, the same basis for both methane concentration and flow measurement will be considered according to the tools.

During this monitoring period, there were several periods of which the LFG temperature exceeds 60^{o}C. Hence, the tool was applied in the CER Calculation sheet as a conservative approach. The details of the calculation are as attached in **Appendix 4**.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Monitoring equipment:

Item	Flare No.1 Description	
	01/04/2014 - 19/11/2014	20/11/2014 - 31/03/2015
Type	PR Electronics (5335A) Temperature Transmitter	
Accuracy class	≤ ± 0.05% of span	
Serial No.	100944768	
Calibration frequency	Annually	
Date of last calibration	10/12/2013	20/11/2014
Validity	1 year	

Item	Flare No.2 Description	
	01/04/2014 – 28/04/2014	29/04/2014 - 31/03/2015
Type	Honeywell (STT25M-0-EN0-000-000-000-00-3D) Temperature Transmitter	
Accuracy class	± 0.5% of span	
Serial No.	B839917437	
Calibration frequency	Annually	
Date of last calibration	25/04/2013	29/04/2014
Validity	1 year	

Item	GSS Description	
	01/04/2014 – 08/05/2014	09/05/2014 - 31/03/2015
Type	Honeywell (STT25M-0-ENS-000-000-000-00-3H) Temperature Transmitter	
Accuracy class	± 1%	
Serial No.	b527143837	
Calibration frequency	Annually	
Date of last calibration	11/06/2012	09/05/2014
Validity	1 year	

Flare No.2

Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment calibration error was applied to TT1 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

GSS (Gas Engine No. 2 and 3)

Due to overdue calibration, the maximum permissible error of ±1% which is the equipment accuracy error was applied to TT1 from 01/04/2014 - 08/05/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Measuring/ Reading/ Recording frequency:	Measured continuously by temperature meter
Calculation method (if applicable):	Raw data logged at 1 minute's interval was used to compute the daily average readings
QA/QC procedures:	The temperature transmitter was calibrated regularly according to the manual given by the manufacturer
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**P ($P_{PT2,F1}$, $P_{PT2,F2}$, $P_{PT2,GSS}$)**
Unit:	kPa
Description:	Pressure of the LFG
Measured/ Calculated / Default:	Measured
Source of data:	Continuous measurement by pressure transmitter. This parameter was measured separately for both flares and the gas engines, i.e. Flare No.1 (1 meter), Flare No.2 & Gas Engine No.1 (1 meter) and Gas Engine No.2 and No.3 (1 meter). Therefore, 3 sets of equipment have to be used for the monitoring period. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Value(s) of monitored parameter:

Gauge pressure (Months)	Flare No.1 Value (kPa)	Flare No.2 Value (kPa)	GSS Value (kPa)
April 14	5.34	9.89	16.96
May 14	5.70	10.54	16.98
June 14	5.85	10.22	16.00
July 14	4.99	9.66	16.99
August 14	5.69	9.48	15.78
September 14	5.06	9.99	16.98
October 14	5.26	10.04	17.01
November 14	6.00	10.35	16.99
December 14	5.49	9.98	16.66
January 15	5.16	10.56	16.95
February 15	5.00	9.80	17.98
March 15	4.47	9.56	17.93
Average	**5.33**	**10.00**	**16.93**

Absolute pressure (Months)	Flare No.1 Value (kPa)	Flare No.2 Value (kPa)	GSS Value (kPa)
April 14	106.67	111.22	118.28
May 14	107.03	111.87	118.31
June 14	107.18	111.54	117.32
July 14	106.31	110.98	118.31
August 14	107.01	110.80	117.10
September 14	106.39	111.32	118.31
October 14	106.58	111.36	118.33
November 14	107.32	111.67	118.32
December 14	106.81	111.30	117.99
January 15	106.48	111.88	118.27
February 15	106.32	111.12	119.31
March 15	105.79	110.89	119.26
Average	**106.66**	**111.33**	**118.26**

Referring to the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream* (Version 2.0), page 11, pressure at normal conditions is 101,325 Pa. The values of the absolute pressure are calculated by adding the ambient pressure at normal conditions to the gauge pressure.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Monitoring equipment:

Item	Flare No.1 Description	
	01/04/2014 - 19/11/2014	20/11/2014 - 31/03/2015
Type	Rosemount (3051TG1A2B21AB4E5M5Q4) Pressure Transmitter	
Accuracy class	± 0.25%	
Serial No.	02492864	
Calibration frequency	Annually	
Date of last calibration	10/12/2013	20/11/2014
Validity	1 year	

Item	Flare No.2 Description	
	01/04/2014 – 28/04/2014	29/04/2014 - 31/03/2015
Type	Rosemount (3051TG1A2B21AB4E5Q4) Pressure Transmitter	
Accuracy class	± 0.25%	
Serial No.	5584784	
Calibration frequency	Annually	
Date of last calibration	25/04/2013	29/04/2014
Validity	1 year	

Item	GSS Description	
	01/04/2014 – 08/05/2014	09/05/2014 - 31/03/2015
Type	Rosemount (3051TG1A2B21AB4K5M5) Pressure Transmitter	
Accuracy class	± 0.1%	
Serial No.	5916057	
Calibration frequency	Annually	
Date of last calibration	13/06/2012	09/05/2014
Validity	1 year	

Flare No.2

Due to overdue calibration, the maximum permissible error of ±0.25% which is the equipment calibration error was applied to PT2 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

GSS (Gas Engine No. 2 and 3)

Due to overdue calibration, the maximum permissible error of ±0.17% which is the equipment calibration error was applied to PT2 from 01/04/2014 - 08/05/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Measuring/ Reading/ Recording frequency:	Measured continuously by a pressure transmitter
Calculation method (if applicable):	Raw data logged at 1 minute's interval was used to compute the daily average readings
QA/QC procedures:	The meter was checked and calibrated regularly according to the manual given by the manufacturer
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**EL_{LFG}**
Unit:	MWh
Description:	Net amount of electricity generated using landfill gas
Measured/ Calculated / Default:	Measured
Source of data:	Data as measured by electricity meters. This parameter was measured separately for the gas engines, i.e. Gas Engine No.1 (1 meter) and Gas Engine No.2 and No.3 (1 meter). Therefore, 2 sets of equipment have to be used for the monitoring period.
Value(s) of monitored parameter:	There were 2 sets of power meters used to measure the amount of electricity sold to the grid, i.e. the main energy meter and check energy meter. Only the readings recorded by the main energy meter was used by the grid operator and the project participant in the calculation of CERs while the readings recorded by the check energy meter were only used to check or confirm on the readings recorded by the main energy meter. From the comparison of the EL4 – EL3 and EL5 (main meter), the lower value between the two is taken for the calculation of net amount of electricity generated for Gas Engine No.1. From the comparison of the EL9 + EL10 – EL7 – EL8 and EL11 (main meter), the lower value between the two is taken for the calculation of net amount of electricity generated for Gas Engine No.2 and No.3. The detailed calculation was shown in the CER calculation sheet under each monthly 'ELPJ' tab.

Months	Net amount of electricity generated (MWh)
April 14	1,979.84
May 14	2,136.82
June 14	2,038.31
July 14	2,123.86
August 14	1,848.66
September 14	2,199.75
October 14	1,978.17
November 14	1,898.96

December 14	1,866.34
January 15	1,910.97
February 15	1,885.67
March 15	1,964.62
Total	**23,832**

Monitoring equipment:

Item	Flare No.2 Description (EL4)		Flare No.2 Description (EL5)	
	01/04/2014-02/10/2014	03/10/2014-31/03/2015	01/04/2014 - 31/03/2015	
			Main energy meter	Check energy meter
Type	EDMI Limited (Mk6E) Power Meter		Itron (SL761A071) Power Meter	
Accuracy class	Class 0.5S		Class 0.20	
Serial No.	210225256		53099690	53099691
Calibration frequency	24 months		5 years	
Date of last calibration	23/07/2012	03/10/2014	01/04/2011	
Validity	24 months		5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)	

Item	GSS Description (EL9)	GSS Description (EL10)
	01/04/2014 - 31/03/2015	01/04/2014 - 31/03/2015
Type	EDMI Limited (Genius) Power Meter	EDMI Limited (Genius) Power Meter
Accuracy class	Class 0.5S	Class 0.5S
Serial No.	211516862	211516863
Calibration frequency	24 months	24 months
Date of last calibration	08/04/2013	09/04/2013
Validity	24 months	24 months

Item	GSS Description (EL11)	
	01/04/2014 - 31/03/2015	
	Main energy meter	Check energy meter
Type	EDMI (Mk6E) Power Meter	
Accuracy class	Class 0.5S	
Serial No.	908705152	908705154
Calibration frequency	5 years	
Date of last calibration	06/12/2009	
Validity	5 years (Type 2 according to the Malaysian Grid Code, version 1/2010)	

Flare No.2

Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL4 from 23/07/2014 - 02/10/2014 as a conservative approach.

GSS (Gas Engine No. 2 and 3)

The meter is owned by the grid operator, TNB and thus, it is not within the control of the project. However, due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to

	EL11 from 06/12/2014 – 31/03/2015 as a conservative approach.
Measuring/ Reading/ Recording frequency:	Measured continuously with electricity meter installed.
Calculation method (if applicable):	NA
QA/QC procedures:	As a quality control procedure, the amount of electricity actually uploaded to grid will be measured by other electricity meters (EL5 and EL11) and compared with the net amount derived from above. Lower value of the amount will be taken as the net amount for emission reduction calculations. Electricity meters (except the meters owned by the grid operator, i.e. EL5 and EL11) will be checked and calibrated regularly according to manufacturer's recommendations. The meters EL5 and EL11 are owned by the grid operator and thus, they are not within the control of the project. The calibration of these meters will be based on the grid operator's requirement and standard practice.
Purpose of data:	Baseline emission calculation
Additional comment:	-

Data / Parameter:	**$CEF_{elec,PR,y}$**
Unit:	tCO_2/MWh
Description:	Carbon emission factor of electricity
Measured/ Calculated / Default:	Calculated
Source of data:	Grid connected baseline for Peninsular Malaysia for 2012 by Malaysian Green Technology Corporation (MGTC)
Value(s) of monitored parameter:	**0.741** tCO_2/MWh based on the latest released grid connected baseline emission factor for Peninsular Malaysia for 2012
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	To be re-calculated with the latest release of grid connected baseline emission factor. The emission factor for year 2012 was applied for this monitoring period as this was the latest publicly released data for the grid emission factor for Malaysia during this monitoring period.
Calculation method (if applicable):	The **$CEF_{elec,PR,y}$** was calculated based on the *Tool to calculate the emission factor for an electricity system* (Version 2, EB 50)
QA/QC procedures:	NA
Purpose of data:	Baseline and Project emission calculation
Additional comment:	-

Data / Parameter:	**Operation of the energy plant (t)**
Unit:	Hours
Description:	Operation of the energy plant

<table>
<tr><td>Measured/
Calculated /
Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Based on actual documented operating hours.

This parameter was measured separately for the gas engines, i.e. Gas Engine No.1 (1 meter) and Gas Engine No.2 and No.3 (1 meter).</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Gas Engine No. 1
Operating time (hr)</th><th>Gas Engine No. 2
Operating time (hr)</th><th>Gas Engine No. 3
Operating time (hr)</th></tr>
<tr><td>April 14</td><td>683</td><td>691</td><td>633</td></tr>
<tr><td>May 14</td><td>400</td><td>737</td><td>712</td></tr>
<tr><td>June 14</td><td>576</td><td>642</td><td>662</td></tr>
<tr><td>July 14</td><td>734</td><td>739</td><td>734</td></tr>
<tr><td>August 14</td><td>589</td><td>654</td><td>584</td></tr>
<tr><td>September 14</td><td>599</td><td>705</td><td>685</td></tr>
<tr><td>October 14</td><td>735</td><td>727</td><td>394</td></tr>
<tr><td>November 14</td><td>363</td><td>691</td><td>700</td></tr>
<tr><td>December 14</td><td>570</td><td>686</td><td>612</td></tr>
<tr><td>January 15</td><td>693</td><td>628</td><td>657</td></tr>
<tr><td>February 15</td><td>502</td><td>668</td><td>663</td></tr>
<tr><td>March 15</td><td>334</td><td>725</td><td>738</td></tr>
<tr><td>Total</td><td>6,778</td><td>8,293</td><td>7,774</td></tr>
</table>

The operating time is calculated by using the reading on the 1st day of the following month (m+1) to deduct the reading on the 1st day of the current month (m). The reading used is the total of the operating time at operation hour and operation hour since oil change as stated in the Daily Monitoring Log Sheet for Gas Engine No.1, row No. 6 and for Gas Engine No. 2 and No. 3.</td></tr>
<tr><td>Monitoring equipment:</td><td>The operation time of the Gas Engine No.1, No.2 and No.3 is recorded by the Gas Engine SCADA system known as Total Energy Management (TEM) Evo System. The operation hour of the Gas Engine No.1, No.2 and No.3 is based on the signal provided by the power meter (EL4, EL9 and EL10).</td></tr>
<tr><td>Measuring/
Reading/
Recording frequency:</td><td>The operation time is recorded continuously and aggregated into monthly data. A daily reading and recording is taken.</td></tr>
<tr><td>Calculation method
(if applicable):</td><td>NA</td></tr>
<tr><td>QA/QC procedures:</td><td>The system will be checked periodically by the engine manufacturer during servicing. The source of the operational hours is from the power meters EL4, EL9 and EL10 which are calibrated regularly according to requirement by the manufacturer.</td></tr>
<tr><td>Purpose of data:</td><td>NA</td></tr>
<tr><td>Additional comment:</td><td>-</td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>$EL_{PJ,y}$</td></tr>
<tr><td>Unit:</td><td>MWh</td></tr>
<tr><td>Description:</td><td>Quantity of electricity consumed by project activity</td></tr>
<tr><td>Measured/ Calculated / Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Based on continuous measurement by sealed electricity meter installed.

This parameter was measured separately for:

<u>01/04/2014 – 13/06/2014</u>
a) Flare No. 1, Flare No. 2 and Gas Engine No.1 – 1 meter (EL1)

b) Gas Engine No.2 & 3 auxiliaries and GSS – 1 meter (EL6)

<u>14/06/2014 – 31/03/2015</u>
a) Flare No. 1, Flare No. 2, Gas Engine No.1, No.2 & No.3 auxiliaries and GSS – 1 meter (EL6). EL1 was not used during this period and the quantity of electricity consumed by project activity was measured by EL6</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Electricity consumed (from grid for project activity-flaring system & Gas Engine No.1) (EL1) (MWh)</th><th>Electricity consumed (from grid for project activity-Gas Engine No.2 & 3 auxiliaries and GSS) (EL6) (MWh)</th></tr>
<tr><td>April 14</td><td>62.93</td><td>200.87</td></tr>
<tr><td>May 14</td><td>54.54</td><td>207.57</td></tr>
<tr><td>June 14</td><td>31.91</td><td>91.04</td></tr>
<tr><td>July 14</td><td></td><td>179.93</td></tr>
<tr><td>August 14</td><td></td><td>159.12</td></tr>
<tr><td>September 14</td><td></td><td>160.68</td></tr>
<tr><td>October 14</td><td></td><td>155.02</td></tr>
<tr><td>November 14</td><td></td><td>148.51</td></tr>
<tr><td>December 14</td><td></td><td>161.39</td></tr>
<tr><td>January 15</td><td></td><td>163.89</td></tr>
<tr><td>February 15</td><td></td><td>153.42</td></tr>
<tr><td>March 15</td><td></td><td>151.65</td></tr>
<tr><td>Total</td><td>149</td><td>1,932</td></tr>
</table>

Note:
During the monitoring period, electricity consumed (from grid for project activity-flaring systems & Gas Engine No.1) (EL1) from 01/04/2014 – 13/06/2014 is applied in the CER calculation sheet.

From 01/04/2014 – 13/06/2014, there was no readings captured for EL6 and therefore, the calculations were estimated for the power consumption of Gas Engine No.2 & 3 auxiliaries and GSS using the power rating (technical</td></tr>
</table>

specifications) of the auxiliaries system involved during the power generation. The power consumed is calculated based on the operating maximum capacity for the full period, including the 10% addition to account for transmission and distribution losses, according to paragraph 2 (3), Appendix 1 of the CDM Project Standard, version 09.0, if project participants have temporarily not monitored parameters related to project GHG emissions or are unable to produce evidence related to such monitoring, prior approval by the Board is not required if project participants estimate these parameters assuming that the source of the GHG emissions operated at maximum capacity for the full period of the missing data. In the case of project GHG emissions related to the consumption of electricity, the estimate shall include an addition of 10% to account for transmission and distribution losses (refer to 'Est EL6' tab for detailed calculations).

Months	Electricity consumed (from GE for Flare No.1 & Flare No.2 & GE auxiliaries) (EL3) (MWh)	Electricity consumed (from GE for GSS) (EL7) (MWh)	Electricity consumed (from GE for Gas Engine No.2 and No.3 auxiliaries) (EL8) (MWh)
April 14	0.00	0.00	0.00
May 14	0.00	0.00	0.00
June 14	0.00	0.00	0.00
July 14	0.00	0.00	0.00
August 14	0.02	0.00	0.00
September 14	0.00	0.00	0.00
October 14	0.00	0.00	0.00
November 14	0.00	0.00	0.00
December 14	0.00	0.00	0.00
January 15	0.00	0.00	0.00
February 15	0.00	0.00	0.00
March 15	0.00	0.00	0.00
Total	**0**	**0**	**0**

Electricity consumed from the Gas Engines for Flare No.1 & Flare No.2 and Gas Engine No.1, No.2 and No.3 auxiliaries and GSS (EL3, EL7 and EL8) is not included in the calculation of project emission as the electricity is generated from landfill gas.

No power from Gas Engine No.2 and No.3 was used for Gas Engine No.2 and No.3 auxiliaries and Gas Supply System (GSS) during the monitoring period. Therefore, there was no data captured for EL7 and EL8.

Flare No.2 (EL3)

There was no reading recorded from 01/04/2014 - 21/08/2014 and from 23/08/2014 - 31/03/2015 as testing was done on the impact towards the operations of Flare No.1 & 2 when the gas engine shuts down.

GSS (Gas Engine No. 2 and 3) (EL7 and EL8)

During the monitoring period, no readings were taken for EL7 and EL8. Only power from the grid was used and no power from Gas Engine No.2 and No.3

was used for Gas Engine No.2 and No.3 auxiliaries and Gas Supply System (GSS) during the monitoring period.

Item	Electricity consumed from grid for project activity-flaring system & Gas Engine No.1 (EL1) (MWh)		Electricity consumed from grid for project activity-Gas Engine No.2 & 3 auxiliaries and GSS) (EL6) (MWh)
	01/04/2014 - 02/10/2014	**03/10/2014 - 31/03/2015**	**06/12/2013 - 31/03/2014**
Type	IME NEMO 96HD+ (MF96021) Power Meter		IME NEMO 96HDL Power Meter
Accuracy class	Class 0.5S (± 0.5%)		Class 1 (± 1%)
Serial No.	2167890035		2661930098
Calibration frequency	36 months		36 months
Date of last calibration	10/05/2011	03/10/2014	23/07/2014
Validity	3 years according to manufacturer's recommendation		3 years according to manufacturer's recommendation

Monitoring equipment:

Item	Electricity consumed (from GE for Flare No.1 & Flare No.2 & GE auxiliaries) (EL3) (MWh)	Electricity consumed (from GE for GSS) (EL7) (MWh)
	01/04/2014 - 31/03/2015	01/04/2014 - 31/03/2015
Type	IME NEMO 96HD+ (MF96021) Power Meter	IME NEMO 96HDL Power Meter
Accuracy class	Class 0.5S (± 0.5%)	Class 1 (±1%)
Serial No.	2175 4100 36	2175390002
Calibration frequency	36 months	36 months
Date of last calibration	21/06/2012	23/07/2014
Validity	3 years according to manufacturer's recommendation	3 years according to manufacturer's recommendation

Item	Electricity consumed (from GE for Gas Engine No.2 and No.3 auxiliaries) (EL8) (MWh)	
	01/04/2014 – 21/12/2014	22/12/2014 – 31/03/2015
Type	Schneider Electric DM6000 Power Meter	
Accuracy class	1.0 % of reading (current and voltage)	
Serial No.	CO34120930959	
Calibration frequency	2 years	
Date of last calibration	23/03/2010	22/12/2014
Validity	2 years according to calibrator's recommendation	

Flare No.2

Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL1 from 10/05/2014 - 14/06/2014 as a conservative approach. Starting from 14/06/2014, EL1 meter is not used and data recording was replaced with EL6. Thus, power consumption by project activity from the grid (flaring systems, Gas Engine No.1, No.2 and No.3) was recorded by EL6.

GSS (Gas Engine No. 2 and 3)

EL6 - During the monitoring period from 01/04/2014 – 13/06/2014, no readings were taken for EL6 due to technical issues. Estimation for the power consumption of Gas Engine No.2 & No.3 auxiliaries and GSS is done by using the power rating (technical specifications) of the auxiliaries system involved during the power generation. The calibration was overdue and the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL6 from 01/04/2014 - 22/07/2014 as a conservative approach. Since there were no readings taken from 01/04/2014 – 13/06/2014, there was no impact of applying this error to the records during this period.

EL7 - There was no power from Gas Engine No.2 and No.3 used for Gas

	Engine No.2 and No.3 auxiliaries during the monitoring period due to operational and technical issues. Therefore, there was no data captured for EL7. The calibration was overdue and the maximum permissible error of ±0.5% which is the equipment accuracy error was applied to EL7 from 01/04/2014 - 22/07/2014 as a conservative approach. Since there were no data captured, there was no impact of applying this error to the records. EL8 - There was no power from Gas Engine No.2 and No.3 used for Gas Supply System (GSS) during the monitoring period due to operational and technical issues. Therefore, there was no data captured for EL8. The calibration was overdue and the maximum permissible error of ±1.0% which is the equipment accuracy error was applied to EL8 from 01/04/2014 - 21/12/2014 as a conservative approach. Since there were no data captured, there was no impact of applying this error to the records.
Measuring/ Reading/ Recording frequency:	Continuous measurement
Calculation method (if applicable):	NA
QA/QC procedures:	The electricity meter was tested and calibrated as per the specifications prescribed by the manufacturer
Purpose of data:	Project emission calculation
Additional comment:	-

Data / Parameter:	$\mathbf{T_{flare,y}}$
Unit:	°C
Description:	Temperature in exhaust gas of the enclosed flare
Measured/ Calculated / Default:	Measured
Source of data:	Continuous measurement by temperature transmitter. This parameter was measured separately for both flares, i.e. Flare No.1 and Flare No.2. Therefore, 2 sets of equipment were used for the monitoring period. Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Value(s) of monitored parameter:

Months	Flare No.1 Value (°C)	Flare No.2 Value (°C)
April 14	563.41	830.84
May 14	556.42	866.40
June 14	553.25	822.03
July 14	531.35	785.84
August 14	545.03	852.73
September 14	526.79	884.34
October 14	530.95	876.91
November 14	566.79	910.41
December 14	566.53	882.33
January 15	552.63	862.50
February 15	549.12	818.79
March 15	534.11	832.04
Average	**548.03**	**852.10**

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Monitoring equipment:

Item	Flare No.1 Description	
	01/04/2014 – 28/04/2014	29/04/2014 – 31/03/2015
Type	PR Electronics (5335A) Temperature Transmitter	
Accuracy class	≤ ± 0.05% of span	
Serial No.	110910943	
Calibration frequency	Annually	
Date of last calibration	19/07/2013	29/04/2014
Validity	1 year	

Item	Flare No.2 Description	
	01/04/2014 – 28/04/2014	29/04/2014 – 31/03/2015
Type	Honeywell (STT25M-0-EN0-000-000-000-00 3D) Temperature Transmitter	
Accuracy class	± 0.5% of span	
Serial No.	B838901937	
Calibration frequency	Annually	
Date of last calibration	25/04/2013	29/04/2014
Validity	1 year	

Flare No.2

Due to overdue calibration, the maximum permissible error of ±0.5% which is the equipment calibration error was applied to TT3 from 25/04/2014 - 28/04/2014 as a conservative approach. The impact of applying this error to the flow normalisation is negligible.

Flare No.3

Flare No.3 will be implemented at a later stage and as a result, no data and instrument is available during this monitoring period.

Measuring/ Reading/ Recording frequency:	The enclosed flare is monitored continuously by a temperature meter
Calculation method (if applicable):	Data logged at 1 minute's interval was used to determine the default flaring efficiency for each hour in accordance to the *Tool to determine project emissions from flaring gases containing methane* (EB 28, Annex 13)
QA/QC procedures:	The temperature meter was tested and calibrated as per the specifications prescribed by the manufacturer
Purpose of data:	Project emission calculation
Additional comment:	-

Data / Parameter:	**Relevant policies and circumstances at the beginning of each crediting period**
Unit:	NA
Description:	NA
Measured/ Calculated / Default:	NA

Source of data:	Monitoring of change of policies and circumstances was done by consultation with relevant governmental authorities (Department of Environment and Department of National Solid Waste Management, Malaysia)
Value(s) of monitored parameter:	Not applicable during this monitoring period as it is not at the beginning of the next crediting period
Monitoring equipment:	NA
Measuring/ Reading/ Recording frequency:	To be checked at the beginning of each crediting period
Calculation method (if applicable):	NA
QA/QC procedures:	NA
Purpose of data:	NA
Additional comment:	-

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 total baseline emissions according to ACM0001 (Version 8) were calculated according to the equations below:

$$BE_y = (MD_{project,y} - MD_{BL,y}) \cdot GWP_{CH4} + EL_{LFG,y} \cdot CEF_{elec,BL,y} + ET_{LFG,y} \cdot CEF_{ther,BL,y}$$

BEy	Baseline emissions in year *y* (tCO_2e)
$MD_{project,y}$	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario
$MD_{BL,y}$	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirements, in tonnes of methane (tCH_4)
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4
$EL_{LFG,y}$	Net quantity of electricity produced using LFG, which in the absence of the project activity would have been produced by power plants connected to the grid or by an on-site/off-site fossil fuel based captive power generation, during year *y* (MWh)
$CEF_{elec,BL,y}$	CO_2 emissions intensity of the baseline source of electricity displaced (tCO_2e/MWh)
$ET_{LFG,y}$	The quantity of thermal energy produced utilizing the landfill gas, which in the absence of the project activity would have been produced from on-site/off-site fossil fuel fired boiler, during the year *y* (TJ)
$CEF_{ther,BL,y}$	CO_2 emissions intensity of the fuel used by boiler to generate thermal energy which is displaced by LFG based thermal energy generation (tCO_2e/TJ)

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y}$$

$MD_{flared,y}$	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity (tCH_4)
$MD_{thermal,y}$	Quantity of methane destroyed for the generation of thermal energy (tCH_4)
$MD_{PL,y}$	Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)

$$MD_{flared,y} = (LFG_{flare,y} \cdot w_{CH4} \cdot D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$$

$MD_{flared,y}$	Quantity of methane destroyed by flaring (tCH_4)
$LFG_{flare,y}$	Quantity of landfill gas fed to the flare(s) during the year *y* (m^3)
w_{CH4}	Average methane fraction of the landfill gas as measured during the year *y* (m^3CH_4 / m^3LFG)
D_{CH4}	Methane density (tCH_4 / m^3CH_4)
$PE_{flare,y}$	Project emission from flaring of the residual gas stream in year *y* (tCO_2e). This will be determined following the procedure set in the *"Tool to determine project emissions from flaring gases containing methane"*.

$$MD_{electricity,y} = LFG_{electricity,y} \cdot w_{CH4,y} \cdot D_{CH4}$$

$MD_{electricity,y}$	Quantity of methane destroyed be generation of electricity (tCH_4)
$LFG_{electricity,y}$	Quantity of landfill gas fed into the electricity generator (m^3LFG)
$w_{CH4,y}$	Average methane fraction of the landfill gas as measured during the year *y* (m^3CH_4 / m^3LFG)

Determination of $MD_{project,y}$ for Flare No.1

	$MD_{flared,y} = \{LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$								$MD_{project,y}$
Month	Quantity of LFG to Flare No.1 FT2 Flare No. 1,y (Nm3)	Methane average fraction Flare No.1 WCH4	Density of Methane Flare No.1 DCH4 (t/Nm3)	Total methane Flare No.1 (tCH4)	Global Warming Potential Flare No.1 GWP (tCO2/tCH4)	Emissions from methane Flare No.1 (tCO2e)	PE Flare No.1 (tCO2e)	Quantity of Methane destroyed by flaring MD flared,y (tCH4)	Quantity of methane that would have been destroyed MD project,y (tCH4)
Apr-14	352,766	0.52	0.0007168	130.40	25	3,259.97	341.49	116.74	116.74
May-14	76,830	0.51	0.0007168	28.26	25	706.53	83.86	24.91	24.91
Jun-14	465,175	0.52	0.0007168	172.42	25	4,310.60	437.16	154.94	154.94
Jul-14	412,101	0.51	0.0007168	151.37	25	3,784.27	386.85	135.90	135.90
Aug-14	461,212	0.51	0.0007168	167.06	25	4,176.44	446.75	149.19	149.19
Sep-14	403,831	0.50	0.0007168	145.38	25	3,634.40	384.85	129.98	129.98
Oct-14	422,984	0.48	0.0007168	146.76	25	3,669.06	375.20	131.75	131.75
Nov-14	494,566	0.51	0.0007168	182.45	25	4,561.25	463.75	163.90	163.90
Dec-14	503,406	0.53	0.0007168	190.95	25	4,773.76	493.53	171.21	171.21
Jan-15	468,872	0.55	0.0007168	183.54	25	4,588.51	461.48	165.08	165.08
Feb-15	408,706	0.55	0.0007168	159.96	25	3,998.98	473.06	141.04	141.04
Mar-15	374,637	0.50	0.0007168	133.47	25	3,336.85	428.16	116.35	116.35

Determination of $MD_{project,y}$ for Flare No.2

	$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$								$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$			$MD_{project,y}$
Month	Quantity of LFG to Flare No.2 FT2 Flare No.2,y (Nm3)	Methane average fraction Flare No.2 WCH4	Density of Methane Flare No.2 DCH4 (t/Nm3)	Total methane Flare No.2 (tCH4)	Global Warming Potential Flare No.2 GWP (tCO2/tCH4)	Emissions from methane Flare No.2 (tCO2e)	PE Flare No.2 (tCO2e)	Quantity of Methane destroyed by flaring MD flared,y (tCH4)	Quantity of Landfill Gas Fed into the GE1 FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into the GE1 WCH4	Quantity of methane destroyed by generation of electricity (J*K) * D MD electricity,y (tCH4)	Quantity of methane that would have been destroyed MD project,y (tCH4)
Apr-14	1,163,098.29	0.61	0.0007168	505.85	25	12,646.32	1,284.41	454.48	265,604.73	0.61	115.52	569.99
May-14	1,251,637.42	0.58	0.0007168	522.89	25	13,072.21	1,316.87	470.21	154,957.30	0.58	64.74	534.95
Jun-14	1,167,127.87	0.55	0.0007168	459.81	25	11,495.27	1,159.32	413.44	230,882.68	0.55	90.96	504.40
Jul-14	1,161,002.42	0.53	0.0007168	441.93	25	11,048.25	1,107.97	397.61	282,102.37	0.53	107.38	504.99
Aug-14	1,190,158.74	0.61	0.0007168	519.09	25	12,977.15	1,297.49	467.19	205,403.42	0.61	89.59	556.77
Sep-14	1,170,549.25	0.59	0.0007168	498.66	25	12,466.54	1,284.75	447.27	233,812.66	0.59	99.61	546.88
Oct-14	1,219,399.55	0.59	0.0007168	516.55	25	12,913.86	1,297.84	464.64	296,360.26	0.59	125.54	590.18
Nov-14	1,222,301.22	0.60	0.0007168	527.94	25	13,198.46	1,329.70	474.75	147,925.96	0.60	63.89	538.64
Dec-14	1,230,902.83	0.61	0.0007168	537.60	25	13,440.05	1,364.51	483.02	217,533.02	0.61	95.01	578.03
Jan-15	1,259,471.41	0.61	0.0007168	548.10	25	13,702.42	1,406.82	491.82	254,506.27	0.61	110.76	602.58
Feb-15	1,067,907.98	0.60	0.0007168	457.62	25	11,440.38	1,238.73	408.07	189,682.20	0.60	81.28	489.35
Mar-15	1,113,616.15	0.57	0.0007168	458.67	25	11,466.76	1,239.48	409.09	120,320.40	0.57	49.56	458.65

For Flare No.2, from the monthly comparison of the FT1 and FT2 + FT3 in this monitoring period, the value of FT2 was used in the CER calculation since FT1 is greater than FT2 + FT3. Details on how the comparison was made and which values were used are explained in Section D.2 above for the parameters LFG_{total}, LFG_{flare} and $LFG_{electricity}$.

Determination of $MD_{project,y}$ for GSS

	$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$					$MD_{project,y}$
Month	Density of Methane GSS DCH4 (t/Nm3)	Global Warming Potential GSS GWP (tCO2/tCH4)	Quantity of Landfill Gas Fed into the GSS FT3 LFG electricity,y (m^3 LFG)	Average methane fraction of the Landfill Gas Fed into the GSS WCH4	Quantity of methane destroyed by generation of electricity (D*E) * B MD electricity,y (tCH4)	Quantity of methane that would have been destroyed MD project,y (tCH4)
Apr-14	0.0007168	25	775,945.63	0.57	319.66	319.66
May-14	0.0007168	25	921,311.52	0.59	388.67	388.67
Jun-14	0.0007168	25	826,604.19	0.56	330.88	330.88
Jul-14	0.0007168	25	873,811.20	0.57	357.81	357.81
Aug-14	0.0007168	25	765,303.52	0.50	276.87	276.87
Sep-14	0.0007168	25	876,036.05	0.56	354.46	354.46
Oct-14	0.0007168	25	716,810.52	0.56	288.24	288.24
Nov-14	0.0007168	25	824,730.12	0.56	329.17	329.17
Dec-14	0.0007168	25	762,878.36	0.54	292.60	292.60
Jan-15	0.0007168	25	782,134.90	0.50	279.92	279.92
Feb-15	0.0007168	25	816,108.80	0.56	327.16	327.16
Mar-15	0.0007168	25	927,501.14	0.61	408.56	408.56

Determination of BE_y for Flare No.1

	$(MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$	BEy Flare No.1
Month	Emissions from Flare No.1 (tCO2e)	Total Baseline Emissions Flare No.1 (tCO2e)
Apr-14	2,918.47	2,918.47
May-14	622.67	622.67
Jun-14	3,873.44	3,873.44
Jul-14	3,397.43	3,397.43
Aug-14	3,729.69	3,729.69
Sep-14	3,249.55	3,249.55
Oct-14	3,293.86	3,293.86
Nov-14	4,097.49	4,097.49
Dec-14	4,280.24	4,280.24
Jan-15	4,127.03	4,127.03
Feb-15	3,525.91	3,525.91
Mar-15	2,908.69	2,908.69

Determination of BE_y for Flare No.2

	$(MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$	$EL_{LFG,y} \cdot CEF_{elec,BL,y}$			BEy Flare No.2 & GE1
Month	Emissions from Flare No.2 (tCO2e)	Total electricity generated GE1 EL,LFG,y (MWh)	CoEF for electricity GE1 CEF electricity,y	Baseline Emission from electricity generation GE1 (tCO2e)	Total Baseline Emissions Flare No.2 & GE1 (tCO2e)
Apr-14	14,249.82	463.78	0.741	343.66	14,593.48
May-14	13,373.72	276.78	0.741	205.09	13,578.82
Jun-14	12,609.96	404.49	0.741	299.73	12,909.69
Jul-14	12,624.80	368.74	0.741	273.24	12,898.04
Aug-14	13,919.33	359.37	0.741	266.29	14,185.62
Sep-14	13,671.93	445.79	0.741	330.33	14,002.26
Oct-14	14,754.57	568.16	0.741	421.01	15,175.58
Nov-14	13,466.08	279.22	0.741	206.91	13,672.98
Dec-14	14,450.75	400.17	0.741	296.53	14,747.28
Jan-15	15,064.49	433.46	0.741	321.19	15,385.68
Feb-15	12,233.69	315.15	0.741	233.52	12,467.21
Mar-15	11,466.20	197.34	0.741	146.23	11,612.43

Determination of BE_y for GSS

	$(MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$	$EL_{LFG,y} \cdot CEF_{elec,BL,y}$			BEy GSS
Month	Emissions from GSS (tCO2e)	Total electricity generated GSS EL,LFG,y (MWh)	CoEF for electricity GSS CEF electricity,y	Baseline Emission from electricity generation GSS (tCO2e)	Total Baseline Emissions GSS (tCO2e)
Apr-14	7,991.55	1,516.06	0.741	1,123.40	9,114.95
May-14	9,716.79	1,860.04	0.741	1,378.29	11,095.08
Jun-14	8,272.04	1,633.82	0.741	1,210.66	9,482.70
Jul-14	8,945.17	1,755.12	0.741	1,300.55	10,245.71
Aug-14	6,921.63	1,489.29	0.741	1,103.57	8,025.20
Sep-14	8,861.57	1,753.97	0.741	1,299.69	10,161.26
Oct-14	7,206.04	1,410.01	0.741	1,044.82	8,250.86
Nov-14	8,229.14	1,619.73	0.741	1,200.22	9,429.36
Dec-14	7,314.88	1,466.17	0.741	1,086.43	8,401.31
Jan-15	6,997.94	1,477.51	0.741	1,094.84	8,092.78
Feb-15	8,178.98	1,570.52	0.741	1,163.76	9,342.74
Mar-15	10,214.12	1,767.28	0.741	1,309.56	11,523.68

For this project, the following applies:

1. $MD_{thermal,y}$ and $MD_{PL.y}$ are not applicable (=0) to this project since there are no heat generation and feeding to natural gas pipeline
2. For this project, $MD_{BL,y}$ is zero since there are no destruction or combustion of methane today due to regulatory a 2nd contractual requirements
3. $ET_{LFG,y}$ and $CEF_{ther,BL,y}$ are not applicable (=0) to this project since there are no thermal energy production
4. Density of methane for Flare No.2 LFG is obtained from ACM 0001, version 8.0, page 14
5. Power generation of landfill gas was only implemented in June 2011
6. The grid connected baseline for Peninsula Malaysia for 2012 was applied to this project and the $CEF_{electricity,y}$ calculated was 0.741tCO_2/MWh
7. $MD_{electricity,y}$ is not applicable (=0) for Flare No.1 during this monitoring period as no LFG from Flare No.1 sent to Gas Engine No.1
8. $EL_{LFG,y}$ and $CEF_{elec,BL,y}$ are not applicable (=0) for Flare No.1 during this monitoring period as no LFG from Flare No.1 sent to Gas Engine No.1
9. The total electricity generated ($EL_{LFG,y}$) is the amount based on the monthly invoices to the grid operator (Tenaga National Berhad (TNB)) which is also the lower reading from the comparison between (EL4 + EL9 + EL10 - EL3 - EL7 - EL8) and (EL5 + EL11)
10. With reference to decision 4/CMP7 and paragraph 66 of the EB 69 Meeting Report, for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in Table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon, i.e. 25 tCO_2/tCH_4

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

The total project emissions according to ACM0001 (Version 8) were estimated according to the equations below:

$$PE_y = PE_{EC,y} + PE_{FC,j,y}$$

$$PE_{EC,y} = EC_{PJ,y} \cdot EF_{grid,y} \cdot (1+TDL_y)$$

$PE_{EC,y}$	Project emissions from consumption of electricity by the project activity during the year y (tCO2e/yr)
$EC_{PJ,y}$	Quantity of electricity consumed by the project activity during the year y (MWh)
TDL_y	Average technical transmission and distribution losses in the ECPG in the year y for the voltage level at which electricity is obtained from the grid at the project site
EF_{grid}	Emission factor for the grid in year y (tCO2eq/MWh)

For this project, the following applies:

1. $PE_{fc,y}$ is zero as no heat from fossil fuel is used to generate electricity for this project
2. The grid connected baseline for Peninsula Malaysia for 2012 was applied to this project and the $EF_{grid,y}$ calculated was 0.741tCO_2/MWh
3. TDL = 10% adopted as stated in the revised registered PDD, version 9.0 page 33 (TNB annual report 2007) (http://announcements.bursamalaysia.com/EDMS%5Csubweb.nsf/LsvAllByID/8B0DC73587EFBC114825750B0033ED71?OpenDocument)
4. From 01/04/2014 – 13/06/2014, there were no readings taken for EL6. As a result, the power consumed by Gas Engine No.2, No.3 and GSS was calculated based on the operating maximum capacity for the full period, including the 10% addition to account for transmission and distribution losses, according to Appendix 1, Project Standard (refer to 'Est EL6' tab in CER sheet for detailed calculations).

E.3. Calculation of leakage

No leakage.

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

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	**318,400**	**1,773**	**0**	**Not applicable**	**691,884**	**691,884**

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

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	**282,443**	**316,627**

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

The total CERs claimed in the 9th monitoring period was 10.8% higher as compared to the value reported in the ex-ante calculations.

The total increase of 10.8% is due to the following reasons:

1. Ex-ante GWP, the revised PDD, version 9.0, a default value of GWP 21 has been applied while in the 9th Monitoring Report, the default was updated to GWP 25[13] and applied.
2. Gas Engine No.2 and No.3 have low downtime and have operated in high efficiency as compared to the previous monitoring period (8th monitoring period) as tabulated as below:

8th monitoring period Gas Engine No.2 and No.3 running time

Month	Time (minute) from September 2013 - March 2014		% of total flare running time
	Total actual GE running time	Total time	
GE 2 (hour)	2,617	2,784	94%
GE 3 (hour)	2,295	2,784	82%

9th monitoring period Gas Engine No.2 and No.3 running time

Month	Time (hour) from April 2014 - March 2015		% of total GE running time
	Total actual GE running time	Total time	
GE 2 (hour)	8,293	8,760	95%
GE 3 (hour)	7,774	8,760	89%

Appendix 1: Details on the downtime of Flare No.1

Date	Flaring stopped		Reason	Remarks
	From	To		
05/04/2014	16:03	18:24	Equipment Breakdown	CO_2 reading problem. Change signal isolator
07/04/2014	9:43	11:55	Equipment Breakdown	CO_2 analyzer problem. Change CO_2 analyzer - use spare unit. Faulty unit sent to One Gas master for service
15/04/2014	9:39	20:02	Others: Proper shutdown	Major shutdown for operation. Chen Guan electrical/ transmission works. Request for shutdown, letter from Chen Guan
17/04/2014	10:25	11:28	Maintenance	Check pneumatic valve. Check connection-air compressor, re-connect to Flare 2 air compressor
22/04/2014	9:54	10:03	Others: Proper shutdown	Shutdown for Hydrocare to take back blower #2 for major service and repair at their workshop
24/04/2014	15:38	17:46	Exceed Set Point Limit	O2 above danger set point
29/04/2014	10:30		Others: Proper shutdown	Annual calibration for CDM Equipment by Nectar. Unable to restart. Blower #1 jammed. Call Hydrocare for service. Flare 1 computer problem
		23:59		

[13] With reference to decision 4/CMP7 and paragraph 66 of the EB 69 Meeting Report, for the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in Table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon, i.e. 25 tCO_2/tCH_4. This factor has contributed a significant impact to the increase in CERs.

Date	Flaring stopped		Reason	Remarks
	From	To		
01/05/2014	0:00		Equipment Breakdown	After annual calibration- unable to restart (since 29/4/2014) Blower #1 jammed. Hydrocare service both blower on 02/05/2014 computer CPU problem. Call Interlinx for software/ PLC programme
26/05/2014		16:39		
26/05/2014	17:51		Exceed Set Point Limit	CO2 above danger set point. O2 above danger set point
27/05/2014		9:13		
07/06/2014	21:59	22:27	Exceed Set Point Limit	O2 above danger set point
11/07/2014	7:19	9:56	Power Failure	Site total shutdown. TNB power failure
19/07/2014	3:53	8:57	Equipment Breakdown	Flare 1 Panel. Earth Fault Relay-Faulty, temporary bypass, to power up Flare 1 panel
25/07/2014	22:26	23:15	Exceed Set Point Limit	O2 above danger set point
04/08/2014	17:17	17:45	Exceed Set Point Limit	O2 above danger set point
07/08/2014	10:19	11:04	Maintenance	Proper Shutdown -To change/replace flexible before blower #1
08/08/2014	9:37	10:17	Maintenance	Proper Shutdown -To change/replace flexible before blower #2
14/08/2014	9:46	11:55	Maintenance	To install flexible after blower #1 and #2
27/08/2014	9:18	11:01	Exceed Set Point Limit	O2 above danger set point
28/08/2014	20:17	20:21	Exceed Set Point Limit	CH4 below danger set point
29/08/2014	8:37	9:51	Exceed Set Point Limit	O2 above danger set point
07/09/2014	19:32	20:07	Power Failure	Site total shutdown-TNB power failure
15/09/2014	18:35	18:51	Power Failure	Site total shutdown-TNB power failure
17/09/2014	10:42	11:32	Equipment Breakdown	Blower #1 Error (jammed). Restart with 1 blower - blower #2
23/09/2014	11:21	11:32	Equipment Breakdown	RA Power to change Protection Relay
07/10/2014	9:24	10:04	Exceed Set Point Limit	O2 above danger set point. Check for condensate at inclined pipe
08/10/2014	11:03	11:15	Others: Planned	Planned shutdown to discharge condensate from gas pipe at inclined main transfer pipe
20/11/2014	11:36	13:06	Others: CDM Calibration	Proper shutdown. CDM calibration. Flare 1, 3 equipment
06/12/2014	20:45	20:54	Others: Proper shutdown	Required to shutdown to check/ isolate neutral leakage problem @ EMSB
10/12/2014	14:24	14:33	Others: Proper shutdown	Hydrocare to install Blower #1. Proper shutdown to running 2 blower (Normal system)
11/12/2014	9:59	10:02	Equipment Breakdown	Repaired blower got problem. Temp. high (104^0C)

Date	Flaring stopped		Reason	Remarks
	From	To		
12/12/2014	11:09	11:59	Power Failure	Site total shutdown. TNB power failure
	16:23	17:56	Equipment Breakdown	Main flame is not detected
18/12/2014	14:09	16:35	Others: Proper shutdown	Request by Hydrocare, to test/ monitor Blower #1
23/12/2014	10:57	11:27	Others: Proper shutdown	Proper shutdown, request by Hydrocare to check on Butterfly valve (inlet) blower #1
24/12/2014	10:17	12:20	Power Failure	Site total shutdown. TNB power failure
22/01/2015	16:09	17:34	Power Failure	Site total shutdown. TNB power failure
14/02/2015	4:19	5:57	Exceed Set Point Limit	Flare 1 Shut down (Main flame is not detected). PT 2 overshoot to 23.96 kpa
26/02/2015	9:02	10:39	Exceed Set Point Limit	Oz above danger set point, during testing phase 2B gas pipe connection
04/03/2015	11:00	11:15	Exceed Set Point Limit	Oz above danger set point, during testing Phase 2B - Gas extraction
13/03/2015	15:09		Equipment Breakdown	F1 - Oz analyzer send to F2 - (F2-Oz) analyzer problem. Temporary send to F2 - F1 purge/manual run with normal air. Minimum flow to maintain/prevent blower from jam
17/03/2015		9:50		
26/03/2015	10:27	17:39	Others: Proper shutdown	To test gas extraction at 2A / Ph 1 - Oz high at Flare 2 / GE1 system

Appendix 2: Details on the downtime of Flare No.2

Date	Flaring stopped		Reason	Remarks
	From	To		
01/04/2014	16:26	16:32	Exceed set point limit	Power surge
15/04/2014	10:39	19:10	Others: Proper shutdown	Major shutdown for LFG operation. Chen Guan electrical/ transmission works. Request for shutdown, letter from Chen Guan
29/04/2014	14:02	16:19	Others: Proper shutdown	Annual calibration for CDM equipment by Nectar
09/05/2014	18:07	18:14	Equipment Breakdown	Blower #1 error
19/05/2014	3:41	4:17	Exceed set point limit	CH4 below danger set point
	9:02	10:00	Equipment Breakdown	PLC communications error. Change PLC communication module for Flare 2 together with PLC expansion cable. Tested OK
05/06/2014	9:19	9:22	Others: Data missing	CH4 missing data few seconds (20 sec). To monitor CH4 signal
12/06/2014	9:20	10:47	Maintenance	Proper shutdown. To check/ service moist separator Flare 2. Replace with new filter
11/07/2014	7:18	10:03	Power Failure	Site total shutdown. TNB power failure

Date	Flaring stopped		Reason	Remarks
	From	To		
02/08/2014	7:36	7:44	Power Failure	Blower #2 error. Power surge
07/09/2014	19:30	20:10	Power Failure	Site total shutdown. TNB power failure
15/09/2014	18:32	18:47	Power Failure	Site total shutdown. TNB power failure
28/10/2014	16:59	17:11	Exceed set point limit	O2 above danger set point
20/11/2014	10:34	13:05	Other: CDM Calibration	CDM Calibrate F2, 2 equipment
06/12/2014	20:35	21:01	Others: Proper shutdown	Required to shutdown to check/ isolate neutral earth leakage problem @ EMBS
12/12/2014	11:04	12:04	Power Failure	Site total shutdown. TNB power failure
24/12/2014	10:12	12:31	Power Failure	Site total shutdown. TNB power failure
29/12/2014	10:55	11:08	Power Failure	TNB power surge few seconds. LFG system trip. Restart OK
31/12/2014	15:28	15:40	Exceed set point limit	O2 above danger set point
08/01/2015	16:20	17:22	Maintenance	Proper shutdown - F2, blower schedule service
09/01/2015	16:09	16:26	Maintenance	Proper shutdown - to check on Blower #2 oil leaking
22/01/2015	10:19	11:10	Maintenance	Proper shutdown - to check on Blower #2 oil leaking
22/01/2015	16:04	17:33	Power Failure	Site total shutdown. TNB power failure
05/02/2015	7:26	19:54	Others: Proper shutdown	2B pipe point to 450 mm - By THR
07/02/2015	10:22	15:08	Others: Proper shutdown	Main transfer pipe connection 2B - THR. Install + connection - reweld joint due to leaking
09/02/2015	8:54	9:18	Exceed set point limit	CH_4 below danger set point - found that terminal cable for analog signal from CH_4 analyser to PLC damage
11/02/2015	9:38	15:11	Others: Proper shutdown	To testing extraction gas from Phase 2B
26/02/2015	8:46	13:22	Exceed set point limit	Proper shutdown - to testing phase 2B gas pipe connection
04/03/2015	10:19	11:22	Others: Testing	Proper shutdown - to testing Phase 2B,Gas extraction
	16:09	16:29	Others: Proper shutdown	Proper shutdown - to normalize system after testing phase 2B gas extraction
10/03/2015	10:15	17:00	Others: Proper shutdown	To testing phase 2B, Gas extraction
12/03/2015	10:58	12:31	Others: Proper shutdown	Proper shutdown - to testing Phase 2B, Gas extraction
12/03/2015	23:26		Exceed set point limit	Oz above danger set point (25.74%). Temporary used F1 - Oz analyser
13/03/2015		15:33		
16/03/2015	19:06	19:54	Others: Proper shutdown	To install new Oz analyser at F2. KBE's spare unit
24/03/2015	8:17	15:05	Maintenance	Replace Flare stack root by Chien Soon. Installation require shutdown and cooling down
26/03/2015	10:21	10:33	Exceed set point limit	Oz above danger set point
27/03/2015	23:39		Exceed set point limit	CH_4 below danger set point

Date	Flaring stopped		Reason	Remarks
	From	To		
28/03/2015		0:29		

Appendix 3: Details on the downtime of Gas Engine No.1, No.2 and No.3

Date	Gas Engine No.1 Stopped		Description Of Event
	From	To	
01/05/2014	00:00		T206 - Jacket water outlet. Got problem with HT Fan #1. Unable to restart (wait for new/repaired unit). Change spark plug B4 (15/05/14)
15/05/2014		15:35	
24/06/2014	8:31		Schedule maintenance service - major service GDU, service radiator, change scrubber - activated carbon
25/06/2014		17:51	
27/06/2014	2:10		P145 crankcase above 5.0 SPE to check
30/06/2014		22:52	
09/08/2014	17:40		TNB, busbar = 0. Unable to restart. TNB trip. Voltage / power factor unstable
10/08/2014		13:33	
18/08/2014	06:06		Reverse Var. Unable to restart, busbar = 0. Arrange SPE to check the engine
23/08/2014		03:16	
10/09/2014	08:38		Scheduled shutdown - for SPE to install new HT / LT pump + pipe modification works for cooling system. Change all Flexible mbba joints
13/09/2014		15:41	
14/09/2014	15:24		T 206 Jacket water engine outlet. (Cooler water leaking at radiator fan)
15/09/2014		23:56	
05/11/2014	16:31		Power Surge. Restart, PF unstable, wait for SPE to check
06/11/2014		13:36	
17/11/2014	09:15		GE1 proper shutdown for SPE, (1)Engine service /maintenance. (2)Change 4 nos flexible joints [2*HT/2*LT]. (3)SPE / Mirasteh check alternator cable. During inspection, found that GE1. Incomer (G1-VCB) current transformer insulation for all. 3 Phases - melt. Inside the panel found dead rat. Chen Guan/Tamco-to check and rectify the problem before GE1 resume ops
30/11/2014		23:59	
01/12/2014	00:00		GE 1 proper shutdown for SPE, ① SPE / mirastech check alternator cables. During inspection, found that GE 1 - incomer (G1-VCB) current transformer insulation for all 3 phases-melt. Chen Guan & Tamco to check * repair
07/12/2015		12:01	
22/12/2014	17:45		Mains Fault. Wait for TNB to reset breaker
23/12/2015		8:45	
08/01/2015	9:47		Proper shutdown - to service scrubber tank + Radiator fan + GDU
09/01/2015		19:19	
26/01/2015	23:01		Proper shutdown. To check spark plug with Gas Engine 2
27/01/2015		08:45	
21/02/2015	21:36		Fault - Low lube oil. Leaking from sampling outlet valve. Cause lube oil disperse & spread. Install temporam screw to stop leakage
22/02/2015		12:10	
23/02/2015	20:20		E 198 Actual power Generator Fault. To change / replace sampling outlet valve
24/02/2015		17:26	

Date	Gas Engine No.1 Stopped		Description Of Event
	From	To	
25/02/2015	04:15		E 198 Actuator power generator. After troubleshooting found that Agem Damage
28/02/2015		23:59	
01/03/2015	00:00		Actual power generator. After troubleshooting found that AGCM damage. SPE to replace AGCM.GDU trip - AEFL Flow
03/03/2015		18:22	
03/03/2015	19:34		GDU trip - AEFL Flow. SPE to check
04/03/2015		17:00	
10/03/2015	10:06		To testing phase 2B, Gas extraction
11/03/2015		17:52	
12/03/2015	10:53		Proper shutdown, to testing phase 2B. Gas extraction. Unable to restart immediately, GDU AEFL fault
14/03/2015		17:33	
15/03/2015	08:06		GDU problem - AEFL fault. Unable / Frequent trip due to same fault. SPE to send contractor for checking & repair
25/03/2015		11:10	
27/03/2015	23:39		Proper shutdown. Flare 2 - CH_4 below danger set point
28/03/2015		00:57	

Date	Gas Engine No.2 Stopped		Description Of Event
	From	To	
15/04/2014	10:20		Major shutdown for LFG operation. Chen Guan electrical/transmission works. GE2 schedule service 1,500 hrs
16/04/2014		11:24	
04/06/2014	09:02		Proper shutdown. Major scheduled maintenance works. Service GDU / Radiator HT / LT. Change Activated carbon - Scrubber 2 & 3. Chen Guan - Change transformer silica gel. GSS free mn with normal air .Chen Guan relocate - cond.
07/06/2014		1:00	
19/08/2014	08:57		Proper shutdown. TNB breaker open for Chen Guan to check transmission line with TAMCO - Charging motor. Continue with exhaust modification by SPE / Istiq
23/08/2014		04:37	
05/11/2014	16:30		Power Surge. Unable to restart immediately, battery changer problem. Engine just crank wait for SP Energy
06/11/2014		17:35	
06/12/2014	15:09		GSS trip. Fault Gas pressure low. Unable to restart - found neutral leakage at GSS panel. Check / Isolate to identity faulty equipment. After checking / isolate all possible faulty equipment found that GE3-water heater is faulty. Turn OFF and isolate the equipment & restart the system
07/12/2015		15:57	
12/12/2014	11:02		Site total shutdown. TNB power failure. Unable to restart. TNB shutdown for 33kw line due to cable fault @ TNB PMU BB. TNB reset / Energise power back on Saturday noon
13/12/2015		15:17	
06/01/2015	10:02		Proper shutdown - to service scrubber tank + Radiator Fan + GDU
09/01/2015		18:46	

Date	Gas Engine No.3 Stopped		Description Of Event
	From	To	
23/04/2014	17:52		Power surge at GSS - tripped. GE2/GE3 trip, low gas pressure. Restart GSS. Gas mixer problem + lube oil temperature high. Reset gas mixer + recheck sensor for lube oil temperature. Wait for battery full recharge
26/04/2014		13:20	
06/05/2014	12:55		Request by SP Energy for schedule service
07/05/2014		13:25	
04/06/2014	09:07		Proper shutdown. Major scheduled maintenance works. Service GDU / Radiator HT / LT. Change Activated carbon - Scrubber 2 & 3.Chen Guan - Change transformer silica gel / relocate air cond. GSS free mn with normal air
06/06/2014		10:39	
16/08/2014	18:07		Oil cooler unit - casing crack. Lube oil leaking getting worst. Must shutdown advised by SPE. Continue with Exhaust modification work for GE 2/GE 3/ by SPE /Istiq - required shutdown - extend
23/08/2014		11:32	
24/09/2014	09:26		Scheduled service at 1,500 hrs. Unable to restart. Found flexible joint damaged
25/09/2014		12:45	
06/10/2014	00:16		Critical fault. After inspection, found that valve spring for A3 chamber broken
20/10/2014		04:45	
05/12/2014	13:25		Throttle Valve position. Unable to restart immediately due to weak starter battery-wait for long hours charging before resume operation
08/12/2015		11:55	
12/12/2014	11:02		Site total shutdown. TNB power failure. Unable to restart. TNB shutdown for 33kv line due to cable fault @ TNB PMU BB.TNB Reset 1 Energise power back on Saturday noon
13/12/2015		15:28	
21/12/2014	17:46		Throttle valve position. Unable to restart immediately, fault cannot reset
22/12/2015		8:43	
06/01/2015	10:07		Proper shutdown - to service scrubber tank + Radiator Fan + GDU + service engine at 1,500 hrs
10/01/2015		16:18	

Appendix 4: Description on the calculation applied in ER Calculation Sheet for Tool to determine the mass flow of a greenhouse gas in a gaseous stream, version 2.0

Referring to the tools, for LFG temperatures below 60 ^{o}C, moisture could be neglected due to its very low influence on final results and thus, the measurement in wet or dry basis is not important (as reflected in the amendments to ACM 0001, version 9.1 onwards). In the case where the LFG temperature exceeds 60^{o}C, the same basis for both methane concentration and flow measurement will be considered according to the tools.

There are 6 measurement options as tabulated below:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow – dry basis	dry or wet basis[3]
B	Volume flow – wet basis	dry basis
C	Volume flow – wet basis	wet basis
D	Mass flow – dry basis	dry or wet basis
E	Mass flow – wet basis	dry basis
F	Mass flow – wet basis	wet basis

During this monitoring period, for Flare No.1 with LFG temperature exceeding 60°C, option B measurement was selected and was applied in the CER calculation.

Determination of the absolute humidity of the gaseous stream

The absolute humidity is a parameter required for Option B. It can be determined from the measurement of moisture content (Option 1) or by assuming the gaseous stream is dry or saturated in a simplified conservative approach (Option 2).

Option 2 which assumes that the gaseous stream is dry or saturated in a simplified conservative approach was selected for the CER calculation.

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal to 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to be equal to the saturation absolute humidity ($m_{H2O,t,db,sat}$) and is calculated using the equation below:

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}}$$

Where:

$m_{H2O,t,db,sat}$ = Saturation absolute humidity in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$p_{H20,t,Sat}$ = Saturation pressure of H_2O at temperature T_t in time interval t (Pa)
T_t = Temperature of the gaseous stream in time interval *t* (K)
P_t = Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)
$MM_{t,db}$ = Molecular mass of the gaseous stream in a time interval *t* on a dry basis (kg dry gas/kmol dry gas)

Parameter	Formula / description
$p_{H20,t,Sat}$	1 | 2 | Filonenko/ Ginzburg (1973) and Filonenko et al. (1971) | 0…100 | $p_s = \exp(6.416 + 17.3 \cdot t / (238+t))$, P_s – Saturation pressure of H_2O t – LFG Temperature
P_t	**Absolute Pressure** $P_a = P_g + P_{at}$ $P_a = P_g + 101325$ where, P_a = Absolute Pressure, P_g = Gauge Pressure, P_{at} = Atmospheric Pressure.

<table>
<tr><th>Parameter</th><th>Formula / description</th></tr>
<tr><td>MM_{H2O}</td><td>18.0152 kg/kmol
Default value from the tool</td></tr>
<tr><td>$MM_{t,db}$</td><td>

$$MM_{t,db} = \sum_{k} (v_{k,t,db} * MM_{k})$$

Where:
$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
$v_{k,t,db}$ = Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (m^3 gas k/m^3 dry gas)
MM_k = Molecular mass of gas *k* (kg/kmol)
k = All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O2, CO, H2, CH_4, N_2O, NO, NO2, SO_2, SF_6 and PFCs). See available simplification below

Default value for $MM_{i,k}$, Gases involve in the calculation are CH_4, CO_2, and O_2

<table>
<tr><td>Data / Parameter:</td><td>MM_i</td></tr>
<tr><td>Data unit:</td><td>kg/kmol</td></tr>
<tr><td>Description:</td><td>Molecular mass of greenhouse gas i</td></tr>
<tr><td>Value to be applied:</td><td>
<table>
<tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg / kmol)</th></tr>
<tr><td>Carbon dioxide</td><td>CO_2</td><td>44.01</td></tr>
<tr><td>Methane</td><td>CH_4</td><td>16.04</td></tr>
<tr><td>Nitrous oxide</td><td>N_2O</td><td>44.02</td></tr>
<tr><td>Sulfur hexafluoride</td><td>SF_6</td><td>146.06</td></tr>
<tr><td>Perfluoromethane</td><td>CF_4</td><td>88.00</td></tr>
<tr><td>Perfluoroethane</td><td>C_2F_6</td><td>138.01</td></tr>
<tr><td>Perfluoropropane</td><td>C_3F_8</td><td>188.02</td></tr>
<tr><td>Perfluorobutane</td><td>C_4F_{10}</td><td>238.03</td></tr>
<tr><td>Perfluorocyclobutane</td><td>c-C_4F_8</td><td>200.03</td></tr>
<tr><td>Perfluoropentane</td><td>C_5F_{12}</td><td>288.03</td></tr>
<tr><td>Perfluorohexane</td><td>C_6F_{14}</td><td>338.04</td></tr>
</table>
</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

<table>
<tr><td>Data / Parameter:</td><td>MM_k</td></tr>
<tr><td>Data unit:</td><td>kg/kmol</td></tr>
<tr><td>Description:</td><td>Molecular mass of gas k</td></tr>
<tr><td>Value to be applied:</td><td>For gases k that are greenhouse gases appy values for MM_i.
<table>
<tr><th>Compound</th><th>Structure</th><th>Molecular mass (kg / kmol)</th></tr>
<tr><td>Nitrogen</td><td>N_2</td><td>28.01</td></tr>
<tr><td>Oxygen</td><td>O_2</td><td>32.00</td></tr>
<tr><td>Carbon monoxide</td><td>CO</td><td>28.01</td></tr>
<tr><td>Hydrogen</td><td>H_2</td><td>2.02</td></tr>
<tr><td>Nitric oxide</td><td>NO</td><td>30.01</td></tr>
<tr><td>Nitrogen dioxide</td><td>NO_2</td><td>46.01</td></tr>
<tr><td>Sulfur dioxide</td><td>SO_2</td><td>64.06</td></tr>
</table>
</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

</td></tr>
</table>

Option B of measurement options

The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,tb} = V_{t,wb}/(1+v_{H2O,t,db})$$

Where:

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

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

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to the equation below:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)

$m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)

$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

The absolute humidity of the gaseous stream ($m_{H2O,t,db}$) is determined using Option 2 above ($MM_{t,db}$) which is as demonstrated above.

Example of the calculation using the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*, version 2.0.

ID	Date	TT1(°C)	TT3(°C)	PT1(kPa)	PT2(kPa)	CH4(%)	CO2(%)	O2(%)	FT1(Nm3/h)	FT2(Nm3/h)	MO2	MCH4	MCO2	MMt,db	MH2O	Patm	Pt	PH2O,T,SAT	mH2O,t,db,SAT	vH2O,t,db	Calculated VFT1,t,db	Calculated VFT2,t,db	New FT2
40	9/17/12 0:1	54.59	855.47	-6.62	18.56	56.23	41.01	1.48	1734.58	1735.36	32.00	16.04	44.01	27.5414	18.0152	101325	119885	15425.0598	0.0966	0.1477	1511.3559	1512.0791	1735.36
41	9/17/12 0:1	54.56	8					1.46	1732.15	1732.06						52	101325	119795	1540				9 1732.06
42	9/17/12 0:2	54.58	8					1.44	1738.58	1735.62						52	101325	119845	1541				5 1735.62
43	9/17/12 0:2	54.52	8					1.44	1739.38	1738.58						52	101325	119835	1537				8 1738.58
44	9/17/12 0:2	54.48	8					1.45	1729.31	1729.14						52	101325	119755	1534				5 1729.14
45	9/17/12 0:2	54.45	8					1.44	1738.51	1737.52						52	101325	119845	1532				0 1737.52
46	9/17/12 0:2	54.45	8					1.42	1740.07	1731.62						52	101325	119885	1532				2 1731.62
47	9/17/12 0:2	54.45	8					1.42	1744.68	1740.56	32.00	16.04	44.01	27.7107	18.0152	101325	119845	1532					4 1740.56
48	9/17/12 0:2	54.45	8					1.41	1730.31	1730.75	32.00	16.04	44.01	27.5926	18.0152	101325	119815	1532					1 1730.75
49	9/17/12 0:2	54.46	863.3	-6.69	18.51	56.32	41.18	1.41	1736.85	1736.63	32.00	16.04	44.01	27.6082	18.0152	101325	119835	1532					4 1736.63
50	9/17/12 0:2	54.45	862.88	-6.66	18.52	56.35	41.28	1.42	1739.38	1738.74	32.00	16.04	44.01	27.6603	18.0152	101325	119845	1532					1 1738.74
51	9/17/12 0:2	54.45	861.84	-6.83	18.46	56.33	41.38	1.42	1736.58	1736.99	32.00	16.04	44.01	27.7011	18.0152	101325	119785	1532					5 1736.99
52	9/17/12 0:3	54.47	861.23	-6.64	18.51	56.55	41.25	1.42	1738.74	1738.31	32.00	16.04	44.01	27.6791	18.0152	101325	119835	1538					4 1738.31
53	9/17/12 0:3	54.45	861.38	-6.62	18.38	56.29	41.22	1.39	1726.35	1725.67	32.00	16.04	44.01	27.6146	18.0152	101325	119705	1532					0 1725.67
54	9/17/12 0:3	54.33	860.02	-6.57	18.38	56.41	41.26	1.4	1729.69	1729.51	32.00	16.04	44.01	27.6547	18.0152	101325	119705	15233.2038	0.0950	0.1458	1509.5762	1509.41	1 1729.51
55	9/17/12 0:3	54.34	859.92	-6.88	18.17	56.61	41.24	1.4	1715.27	1714.58	32.00	16.04	44.01	27.6780	18.0152	101325	119495	15240.5448	0.0952	0.1462	1496.5023	1495.90	3 1714.58
56	9/17/12 0:3	54.33	860.91	-6.81	18.26	56.55	41.41	1.35	1718.76	1718.25	32.00	16.04	44.01	27.7272	18.0152	101325	119585	15233.2038	0.0948	0.1460	1499.8176	1499.37	6 1718.25
57	9/17/12 0:3	54.36	863.2	-6.65	18.33	56.76	41.37	1.32	1723.68	1723.68	32.00	16.04	44.01	27.7336	18.0152	101325	119655	15255.2360	0.0949	0.1461	1503.9220	1503.92	0 1723.68
22	9/17/12 0:0	54.71	867.23	-6.92	18.34	56.34	41.35	1.39	1726.32	1723.94	32.00	16.04	44.01	27.6799	18.0152	101325	119665	15514.3056	0.0969	0.1490	1502.3323	1500.43	9 1723.94
23	9/17/12 0:0	54.68	866.77	-6.67	18.5	56.53	41.49	1.36	1741.48	1740.42	32.00	16.04	44.01	27.7624	18.0152	101325	119825	15491.9527	0.0964	0.1485	1516.2837	1515.40	3 1740.42
24	9/17/12 0:0	54.69	866.53	-6.73	18.4	56.5	41.41	1.36	1737.26	1736.15	32.00	16.04	44.01	27.7223	18.0152	101325	119725	15499.4006	0.0966	0.1487	1512.3485	1511.39	9 1736.15
25	9/17/12 0:0	54.66	864.89	-6.51	18.6	56.35	40.96	1.37	1735.68	1734.69	32.00	16.04	44.01	27.5034	18.0152	101325	119925	15477.0661	0.0971	0.1482	1511.6362	1510.81	5 1734.69
26	9/17/12 0:0	54.68	863.16	-6.51	18.62	56.33	41.05	1.41	1739.68	1739.17	32.00	16.04	44.01	27.5526	18.0152	101325	119945	15491.9527	0.0970	0.1483	1514.9589	1514.54	0 1739.17

LFG Temperature > 60°C

Original value for FT2

FT2 calculated using the tool and is applied in the CER calculation

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

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	KUB-Berjaya Enviro Sdn. Bhd. (KBE)
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Telephone	603-2688 6333
Fax	603-2688 6332
E-mail	iza@kbenviro.com.my
Website	www.kbenviro.com.my
Contact person	How Lim Sek
Title	Chief Operating Officer
Salutation	Mr.
Last name	How
Middle name	-
First name	Lim Sek
Department	-
Mobile	-
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Direct tel.	-
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