MONITORING REPORT FORM (CDM-MR) *
Version 01

CONTENTS

MONITORING REPORT
Version 1.0 – 22nd July 2011
Landfill Gas Recovery and Utilization at Bukit Tagar Sanitary Landfill, Hulu Selangor, Malaysia
Project 2467
Monitoring period and dates (01/01/2011 to 30/06/2011)

SECTION A. General description of the project activity

A.1. Brief description of the 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 wastes 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 from the landfill into the atmosphere through active extraction. The gas collected will be destructed by high temperature enclosed flares as well as to be utilised for power generation using high efficiency gas engine.

Carbon emissions are reduced through two major activities:

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

The LFG extraction from the Advance Cell and first flaring system (Flare No.1) has already been implemented since mid-2009. The gas extraction and flaring system were in general monitored according to the CDM monitoring plan. A revision of monitoring plan is requested within this monitoring period.

The flaring systems receiving landfill gases from Advanced Cell and Phase 1 Cell continues to operate during this monitoring period.

The physical installation works of a 1MW high efficiency gas engine started in April 2010 and the commissioning of gas engine connection to grid was achieved on 2nd June, 2011.

The third monitoring period is from 1st January 2011 to 30th June 2011 (inclusive of both days). The total emission reductions achieved during this monitoring period is **109,381 tCO_2e.**

A.2. Project Participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)
Malaysia (Host)	KUB-Berjaya Enviro Sdn. Bhd. (KBE) (Private)
Japan	Japan Carbon Finance, Ltd. (JCF) (Private)

A.3. Location of the project activity

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.

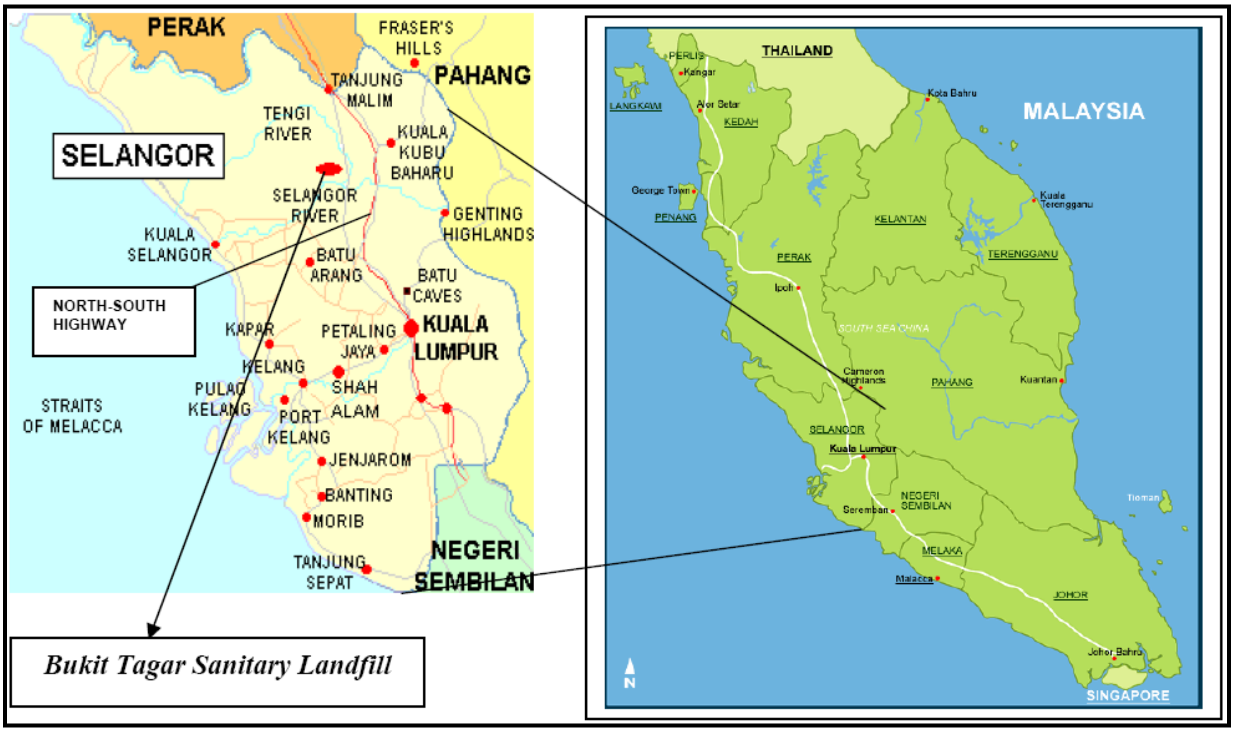


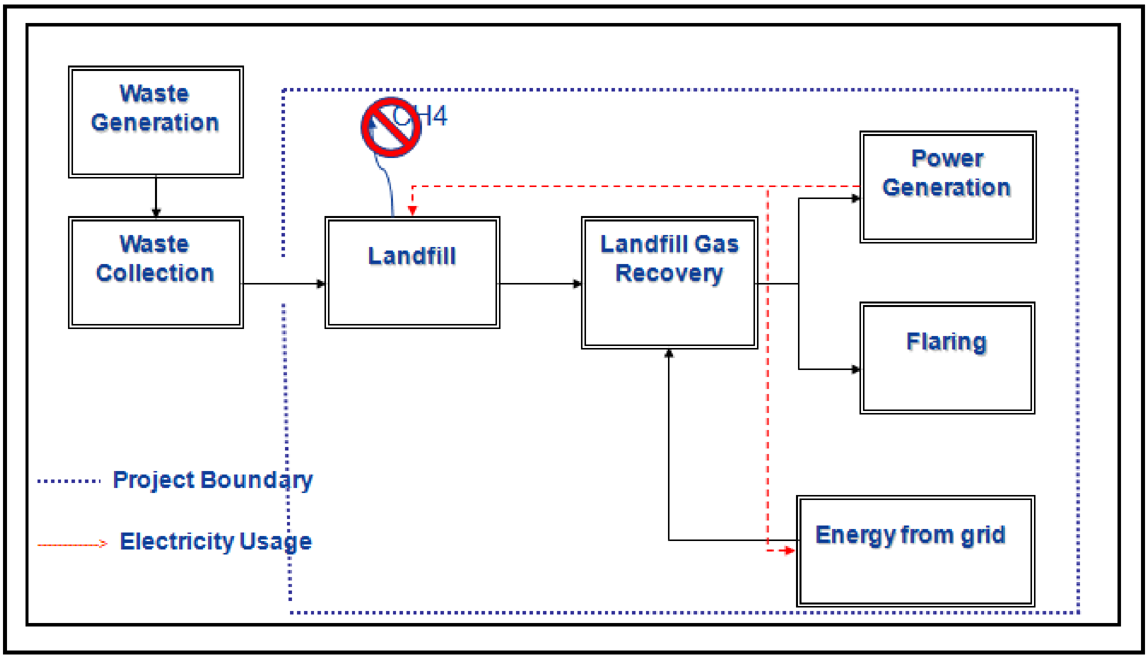
Figure 1: Location of Selangor State and BTSL

The specific geographical coordinates of the landfill are:

Latitude	Longitude	Description
3^{0} 30' 168''	101^{0} 28' 428''	North
3^{0} 29' 07''	101^{0} 28' 452''	South
3^{0} 29' 46''	101^{0} 28' 20''	West
3^{0} 29' 69''	101^{0} 29' 268''	East

A.4. Technical description of the project

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



Note: With reference to paragraph 3, Section A.2, CDM PDD version 5.3, the landfill is being developed in phases. Currently, landfill gas extraction has been implemented on 2 closed cells in the landfill, i.e. Advance Cell and Phase 1. Both of these phases are included in this project, as well as any future phases to be developed in accordance to the PDD.

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

Overall, the LFG technology and design were sourced from developed countries since it was not readily available locally. The technology applied and transferred into this project has been implemented and proven in Europe (Denmark, Germany) as well as China (flaring system).

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 flare 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 2,500Nm^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 – 2,500Nm^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 Analyser and Data Logging

Monitoring of the correct functioning of the flaring 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 in-built data logger to a PC and also transmitted via GSM modem to external server and PC as backup.

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, to be filled according to landfill sequence later. 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 flare 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 2,500Nm^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 – 2,500Nm^3/hr
Retention time	>0.3 seconds at 800-1,000^oC
Gas blower	Two 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 Engine Energy Power Plants

A high efficiency (electrical efficiency > 42%) gas engine (1MW) was chosen for the generation of electricity from LFG.

Figure 7: High Efficiency Landfill Gas Engine in Bukit Tagar

The details of the gas engine specifications are listed below:

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

To ensure good quality LFG arrives at the gas engine, 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 H_2S and siloxanes before the gas engine.

A landfill gas blower was installed to ensure the required gas pressure for gas engine is maintained.

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

The project has applied the following approved methodology and tools:

Approved Methodology:

ACM0001 – Consolidated baseline and monitoring methodology for landfill gas project activities *(Version 8)*

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 5, EB 55, Annex 18)*;
- "Tool to calculate the emission factor for an electricity system" *(Version 2, EB 50, Annex 14)*; and
- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" *(Version 1, EB 39, Annex 7).*

A.6. Registration date of the project activity:

The registration date of Landfill Gas Recovery and Utilization at Bukit Tagar Sanitary Landfill, Hulu Selangor, Malaysia is 28th August 2009.

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

Crediting period of 7 years (renewable) was selected. The start date of first crediting period is 28th August 2009 and the last date of the 7 years will be 27th August 2016.

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

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SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

For the reporting period of 1st January 2011 to 30th June 2011, the key CDM activities implemented are as follow:

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 table below shows the details on the downtime of the system due to installation of equipments used for CDM monitoring, checking of power meter connection and annual calibration for all instruments.

Date	Reason
2nd March 2011 (9:16am – 10:12am)	Checked on TT3 thermocouple at flare stack
8th March 2011 (11:14am – 12:28pm)	Installation of the thermocouple for TT3 transmitter at flare stack
16th March 2011 (7:34pm – 10:28pm)	Problem with sample gas cooler (unable to restart) & all analysers shown low readings with CH_4 readings less than 20% (auto shutdown)
26th April 2011 (11:18am – 7:44pm)	TNB total shutdown at site & preparation of relocation of power meter at TNB sub-station for gas engine start-up on 3rd May
28th April 2011 (10:24am – 1:22pm)	Performed annual instrument calibration by Nectar & conducted system check for CDM-related instruments
6th May 2011 (2:52pm – 3:38pm)	Calibration for electric power meter
27th May 2011 (10:30am – 9:26pm)	TNB power shutdown at site due to installation of panel at TNB sub-station (Pelupusan Sampah) and cabling works for power distribution
21st June 2011 (11:44am – 1:20pm)	Checked on power meter connection at ATS panel for EL1, EL2 & EL3
22nd June 2011 (7:12am – 9:24am)	PT2 transmitter shown negative value during flaring and was changed with a new spare PT2 transmitter
23rd June 2011 (11:18am – 3:32pm)	Checked on power meter connection in the LFG control room for EL1, EL2 & EL3

The total running up time for Flare No.1 was 97% during this monitoring period.

Gas Extraction System in Phase 1 Cell and Flare No.2

The flaring system in Phase 1 was completed during the 2nd monitoring period and started its operation on 7th August 2010. Flare No.2 is located next to Flare No.1 where the LFG extracted from Phase 1 cell is transferred via a transfer pipe and fed to Flare No.2.

The table below shows the details on the downtime of the system due to scheduled blower service, TNB shutdown at site, checking of power meter connection, CH_4 analyser exceeding danger set point limit and annual calibration for all instruments during the monitoring period.

Date	Reason
16th March 2011 (10:49am – 5:22pm)	Blower service & 1st round scheduled service for year 2011
26th April 2011 (11:23am – 7:52pm)	TNB total shutdown at site & preparation of relocation of power meter at TNB sub-station for gas engine start-up on 3rd May
28th April 2011 (3:22am – 3:39am)	CH_4 below danger set point
29th April 2011 (9:40am – 2:33pm)	Performed annual instrument calibration by Nectar & conducted system check for CDM-related instruments
29th April 2011 (8:28pm – 10:27pm)	CH_4 readings have shown minimum readings of < 25% & have triggered the system shutdown
27th May 2011 (10:40am – 9:45pm)	TNB power shutdown at site due to installation of panel at TNB sub-station (Pelupusan Sampah) and cabling works for power distribution
30th May 2011 (10:26am – 9:55pm)	TNB power shutdown for whole site for testing of TNB SCADA system
21st June 2011 (11:14am – 4:51pm)	Checked on power meter connection at ATS panel and problem with pneumatic valve SCADA system
23rd June 2011 (11:21am – 3:21pm)	Checked on power meter connection in the LFG control room for EL1, EL2 & EL3
25th June 2011 (11:04am – 11:38am)	THR checked on SCADA system for problem with valve - FT1, FT2 & FT3 which were not correct

The total running time for Flare No.2 was 89% during this monitoring period.

Power Generation

For this monitoring period, no power was generated from the LFG captured from January – May 2011. Power generation commenced in June 2011 where the uploading to the grid was also achieved.

The timeline for power generation implementation for BTSL project activity is tabulated below:

Date/Duration	Process Description	Details & Status
3rd Jan 2011	1st gas engine delivery	- Delivery of containerised gas engine to Bukit Tagar site
17th Jan 2011	Scheduled Pre-Testing & Commission with change-over system	- T&C was unsuccessful due to issues with internal wiring - Grid Connection was not ready due to the absence of equipment (Pending TNB Approval)
28th Feb 2011	Scheduled 2nd Pre-T&C	- Pre-T&C was successful - The actual T&C was postponed to 4th April due to the delay in manufacture and delivery of

Date/Duration	Process Description	Details & Status
		TNB equipment (Pending approval)
4th April 2011	Scheduled T&C	- Further delay of T&C to 3rd May 2011 due to the postponed FAT and delivery of TNB Equipment
3rd May 2011	Scheduled Site Acceptance Test (SAT) of TNB Equipment	- Rescheduled to 26th May 2011 due to rejection of FAT of TNB equipment. Additional function was requested by TNB to be added at 11kV panel which consumed additional 2 weeks for modification alone.
27th May 2011	Scheduled T&C	- Rescheduled to 1st June 2011 due to punctuality issue and unexpected request by TNB of additional works.
1st & 2nd June 2011	Testing & Commissioning of gas engine	- SAT was accepted by TNB - Tested the capacity of the gas engine and began commissioning the gas engine to generate at load rate (94%) to the TNB grid - Due to absence of inter-tripping system, Gas Engine Contractor informed that the G.E would not be operated without the presence of their technician/engineer
9th June 2011	7-day Endurance Test	- The endurance test began after inter-tripping system was implemented
17th June 2011	Endurance Test Completed	- Completed 7-day continuous operation of Gas Engine

Expansion of Grid Export

According to PDD (page 7 and page 10), KBE planned to sell minimum of 2MW to the TNB grid but it was clearly stated that such planning is subjected to further assessment and consideration. As reported in the second monitoring report, the grid operator only approved and accepted 1MW export capacity in June 10. The current installation of grid export is only for 1 MW. KBE is in discussion with the Government and Power Utility to increase the potential of the grid to accept additional power generation from the landfill site.

On Site Utilisation

As described in previous monitoring period, on-site power utilisation was to be achieved with the additional installation of 1 MW gas engine.

However, after detail studies and negotiation with the grid operator, the utilisation of power generation from landfill gas cannot be implemented due to both technical constraints and commercial viability reasons. (to further elaborate)

A notification of change was requested with this monitoring report.

B.2. Revision of the monitoring plan

The revision of monitoring plan was applied with this monitoring report.

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

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

No deviation during this monitoring period.

B.4. Notification or request of approval of changes

A notification of change for project design was applied with this monitoring report.

The change is related to removal of on-site power utilisation from the PDD due to technical constraints and viability in implementation.

SECTION C. Description of the monitoring system

Monitoring Methodology

The basis of the monitoring plan was formulated based on the approved methodology ACM0001 – Consolidated baseline and monitoring methodology for landfill gas project activities *(Version 8).*

Operation and Management Structure for Monitoring

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

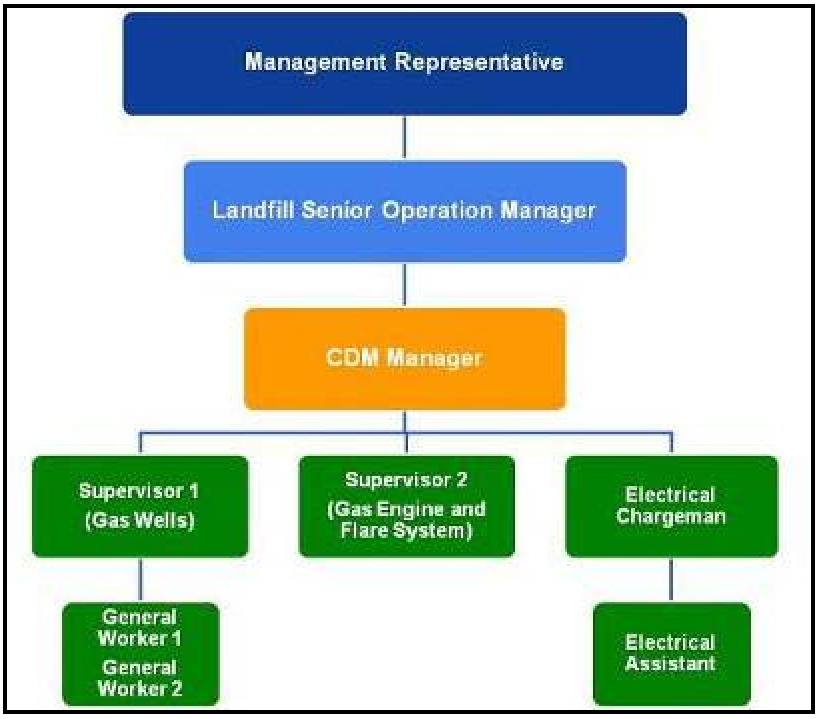


Figure 8: Organisational Structure for CDM Monitoring for BTSL LFG Recovery and Utilisation Project

The roles and responsibilities of the monitoring team in carrying out the monitoring plan 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
Senior Landfill Operation Manager	• Reports to the management representative • Oversees entire operation of landfills (including LFG management system) • Covers responsibility of CDM Manager when he is not available
CDM Manager	• Reports to the Senior Landfill Operation Manager • 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

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 PLC control room. The supervisor will hold the door key for the PLC control room
Electrical Chargeman	• Conducts regular checks on the electrical components of the flaring system • Ensures continuous power supply to flaring system • Identifies and fixes all electrical and electronic faults detected • Ensures all electrical meters are functioning and calibrated as per the supplier requirement / industrial standards • Records the electricity consumption for the flare system in the daily monitoring log sheets
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 management representative (MR) who oversees the entire CDM monitoring implementation. The MR receives direct updates and support from the site staff headed by the Senior Landfill Operation Manager. The Senior Landfill Operation Manager is supported by the CDM Manager who is the key coordinator to all CDM monitoring matters on site. The CDM Manager is assisted by a group of technicians and workers who will perform the daily recording and check 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 monitoring plan. The consultant played the role of a trainer as well as conducting independent audits as part of the QA/QC procedures set up for this project.

During this monitoring period, 2 CDM Management Meetings was held on 14th February 2011 and 10th May 2011 respectively.

Relevant Monitoring Points

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

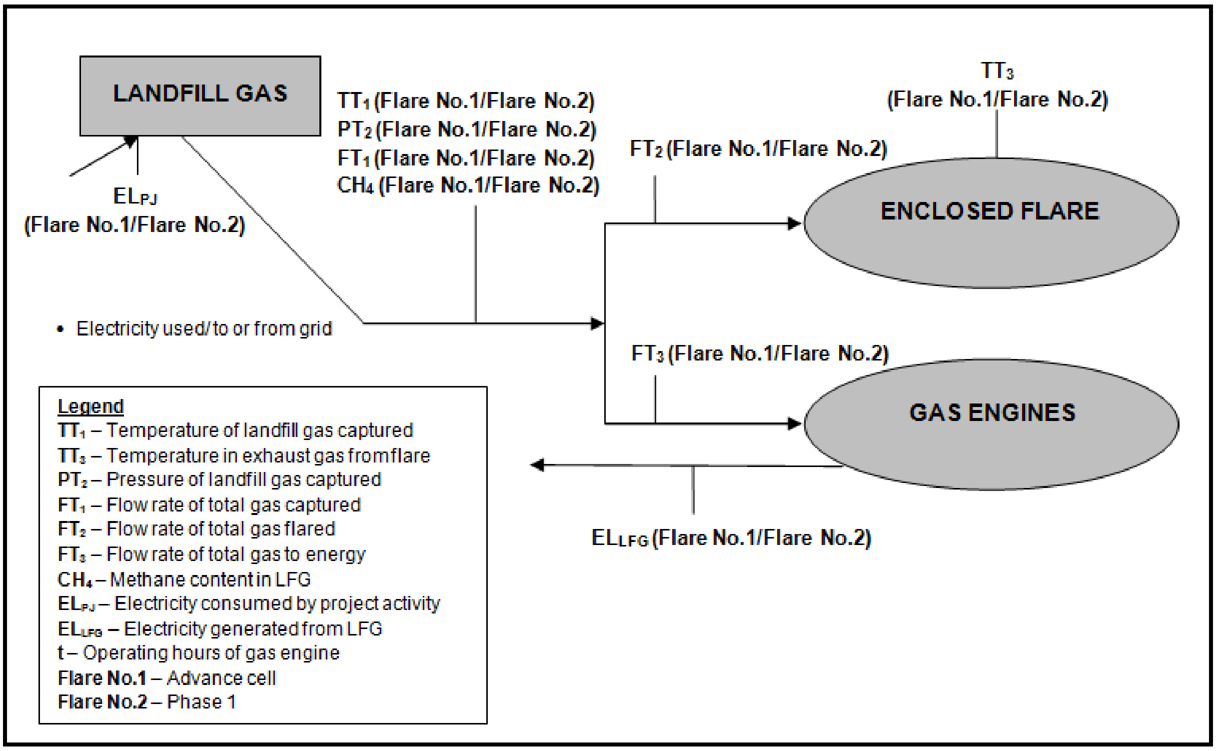


Figure 9: Key Parameters Monitored under the CDM Monitoring Plan

EL_{LFG} and FT_3 were measured during this monitoring period starting from 1st June 2011.

<u>Data Recording and Documentation</u>

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:

<u>Continuous Monitoring – Data in Softcopy:</u>

Data logger (automatic recording in computer)

<u>Manual Recording – Data in Hardcopy:</u>

Daily monitoring log sheets and record books (manual recording)

Based on the monitoring plan, 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	Documentations	Data archive
Temperature	$T_{TT1,F1}$ $T_{TT1,F2}$ $T_{Flare,F1}$ $T_{Flare,F2}$	$TT_{1,Flare\ No.1/\ Flare\ No.2}$ $TT_{3\ ,Flare\ No.1/\ Flare\ No.2}$	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	$P_{PT2,F1}$ $P_{PT2,F2}$	$PT_{2,Flare\ No.1/\ Flare\ No.2}$	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	$LFG_{total,\ Flare\ No.1/\ Flare\ No.2,y}$ $LFG_{flare,\ Flare\ No.1/\ Flare\ No.2,y}$ $LFG_{electricity,\ Flare\ No.2,y}$	$FT_{1,Flare\ No.1/\ Flare\ No.2}$ $FT_{2\ ,Flare\ No.1/\ Flare\ No.2}$ $FT_{3,Flare\ No.2}$	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	Documentations	Data archive
Methane Fraction	$W_{CH4, Flare No.1/ Flare No.2,y}$	$CH_{4,Flare No.1/ Flare No.2}$	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	$EL_{PJ,y}$ $EL_{PJ,GE,Flare No.1 \& 2,y}$ $EL_{PJ,GE,auxiliary \& flare,y}$ $EL_{PJ,grid + GE,Flare No.1/ Flare No.2,y}$	EL_{PJ} $EL_{PJ,GE,Flare No.1 \& 2}$ $EL_{PJ,GE,auxiliary \& flare}$ $EL_{PJ,grid + GE,Flare No.1/ Flare No.2}$	kWh meter	Daily (manual)	Softcopy 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 by project	$EL_{LFG, GE,total,y}$	$EL_{LFG,GE, total}$	kWh meter	Daily (manual)	Softcopy Hardcopy	Data recorded will be compiled into MS Excel and aggregated for monthly amount Daily log sheet will be scanned for archiving

NOTE:
Data recorded by the flow meter 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.

LFG electricity was implemented in this monitoring period.

Monitoring Equipment and Equipment Calibration

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

Table 3: List of CDM Monitoring Equipments 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	Honeywell	STT25M-0-EN0-000-000-000-00-3D	B224836437	±0.5%	0-100°C	28/4/2010 & SB 100601 (1 Jan 11 - 27 Apr 11)	27/4/2011	Annually
											28/4/2011 & SB 110587 (28 Apr 11 - 30 June 11)	27/4/2012	
2	Temperature Transmitter	Flare Temperature ($T_{flare,y}$)	$TT_{3,Flare No.1}$	$T_{Flare,F1}$	°C	1. Honeywell	STT25M-0-EN0-000-000-000-00-3D	B123070037	±0.5%	0-1200°C	15/6/2010 & 03244118 (1 Jan 11 - 7 Mar 11)	14/6/2011	Annually
						2. Beijing Fairyland	Type K Thermocouple	T11-0396-1	0.1°C (resolution)	0-1200°C	3/3/2011 & SB 110454 (8 Mar 11 - 30 June 11)	2/3/2012	
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,Flare No.1}$	$P_{PT2,F1}$	kPa	Rosemount	3051TG1A2B21AB4E5Q4	01873654	±0.25%	0-2 to 0-207 kPa	28/4/2010 & SB 100605 (1 Jan 11 - 27 Apr 11)	27/4/2011	Annually
											28/4/2011 & SB 110590 (28 Apr 11 - 22 June 11)	27/4/2012	
							3051TG1A2B21AB4E5M5Q4	02255815	±0.25%	0-2 to 0-207 kPa	24/6/2010 & 80415781 (22 June 11 - 30 June 11)	23/6/2011	
4	Flow Meter	Total Biogas Flow Rate ($LFG_{total,y}$)	$FT_{1,Flare No.1}$	$LFG_{total,Flare No.1,y}$	NM³/hr	Rosemount / Kingways Control	3051 / KVS10IIKC23FSN	4972946 / FT119 (8102101)	±1%	3-5000Nm³/h	28/4/2010 & SB 100606 (1 Jan 11 - 27 Apr 11)	27/4/2012	24 months
											28/4/2011 & SB 110591 (28 Apr 11 - 30 June 11)	27/4/2013	
5	Flow Meter	Flaring Biogas Flow Rate ($LFG_{flare,y}$)	$FT_{2,Flare No.1}$	$LFG_{flare,Flare No.1,y}$	NM³/hr	Rosemount / Kingways Control	3051 / KVS10IIKC23FSN	4972945 / FT120 (8102102)	±1%	3-5000Nm³/h	28/4/2010 & SB 100607 (1 Jan 11 - 27 Apr 11)	27/4/2012	24 months
											28/4/2011 & SB 110592 (28 Apr 11 - 30 June 11)	27/4/2013	
Gas Analysers													
6	CH_4 Meter	Methane fraction of LFG	$CH_{4,Flare No.1}$	$W_{CH4,Flare No.1,y}$	%	Guardian Plus	97460	28931	±2%	0-100%	28/4/2010 & SB 100608 (1 Jan 11 - 27 Apr 11)	27/4/2011	Annually
											28/4/2011 & SB 110593 (28 Apr 11 - 30 June 11)	27/4/2012	
Power Generation and Electricity Consumption													
7	Power meter	Power consumed	$EL_{PJ,grid-GE,Flare No.1}$	$EL_{PJ,grid-GE,Flare No.1,y}$	kWh	Krizik Slovakia	ET 421 HF612132C	8383258	Class 2 (±2%)	0-999,999kWh	25/4/2010 & SP/RA/2010/134/001-001 (1 Jan 11 - 5 May 11)	24/4/2011	Annually
											6/5/2011 & SP/RA/2011/172/001-001 (6 May 11 - 30 June 11)	5/5/2012	

**The maximum permissible error for PT_2 (+0.25%) was applied starting from 23 June - 30 June 2011 as a conservative approach. The impact of applying these errors to the flow normalisation is negligible.*

**The maximum permissible error for EL_{PJ} (+2%) was applied starting from 25 April 2011 – 05 May 2011 as a conservative approach.*

Span Gas			
No	Parameters	Analysis date	Best if used by
1	N_2, CH_4	2/18/2009	2/18/2014
2	N_2, CO_2	2/3/2009	2/3/2014
3	N_2, O_2	10/26/2009	10/26/2019

Table 4: List of CDM Monitoring Equipments 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	18/5/2010 & RGct2010-0478 (1 Jan 11 - 27 Apr 11) 28/4/2011 & SB 110595 (28 Apr 11 - 30 June 11)	17/5/2011 27/4/2012	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	18/5/2010 & RGcc2010-0057 (1 Jan 11 - 27 Apr 11) 28/4/2011 & SB 110597 (28 Apr 11 - 30 June 11)	17/5/2011 27/4/2012	Annually
3	Pressure Sensor	Pressure Transmitter (P)	$PT_{2,Flare No.2}$	$P_{PT2,F2}$	kPa	Rosemount	3051TG1A2B21AB4E5Q4	5584784	±0.25%	0-2 to 0-207 kPa	17/5/2010 & RGpc2010-0110 (1 Jan 11 - 27 Apr 11) 28/4/2011 & SB 110598 (28 Apr 11 - 30 June 11)	16/5/2011 27/4/2012	Annually
4	Flow Meter	Total Biogas Flow Rate ($LFG_{total,y}$)	$FT_{1,Flare No.2}$	$LFG_{total,Flare No.2,y}$	NM^3/hr	Rosemount / Kingways	3051CD1A22A1AM5K5Q4 / KVS10IIKC23FSN	5476626 / FT141 (10031702)	±0.5%	3-5000Nm^3/h	7/4/2010 & D10-292-JG-02 (1 Jan 11 - 27 Apr 11) 28/4/2011 & SB 110601 (28 Apr 11 - 30 June 11)	6/4/2012 27/4/2013	24 months
5	Flow Meter	Flaring Biogas Flow Rate ($LFG_{flare,y}$)	$FT_{2,Flare No.2}$	$LFG_{flare,Flare No.2,y}$	NM^3/hr	Rosemount / Kingways	3051CD1A22A1AM5K5Q4 / KVS10IIKC23FSN	5476627 / FT140 (10031701)	±0.5%	3-5000Nm^3/h	7/4/2010 & D10-292-JG-01 (1 Jan 11 - 27 Apr 11) 28/4/2011 & SB 110600 (28 Apr 11 - 30 June 11)	6/4/2012 27/4/2013	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	Rosemount / Kingways Control	3051CD1A22A1AM5K5Q4 / KVS08IIKC23FSN	5490821 / FT161 (11011001)	±0.5%	200-2000Nm^3/h	20/1/2011 & D11-046-JG	19/1/2013	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 30548 32560	±2%	0-100%	9/11/2010 & E-0419/1110 (1 Jan 11 - 18 Apr 11) 9/3/2011 & E-0539/1110 (18 Apr 11 - 5 May 11) 5/5/2011 & E-0508/0511 (5 May 11 - 30 June 11)	8/11/2011 8/3/2012 4/5/2012	Annually
Power Generation and Electricity Consumption													
8	Power meter	Energy consumed	$EL_{PJ,grid-GE,Flare No.2}$	$EL_{PJ,grid-GE,Flare No.2,y}$	kWh	Contrel Elettronica S.R.L.	EMM-R4h	4309	±1%	0/999999999kWh / kVArh	15/10/2009 & TR012CIU	14/10/2012	36 months
9	Power meter	Energy generation (MWh)	$EL_{LFG,GE,total}$ (EL4)	$EL_{LFG,GE,total,y}$	kWh (to be converted to MWh)	EDMI Limited	Mk6E	210225256	Class 0.5S	99999999.99kWh	15/7/2010 & 210225256-1918937 (1 June 11 - 30 June 11)	14/7/2011	Annually
10	Power meter	Energy consumed	EL_{PJ} (EL1)	$EL_{PJ,y}$	kWh	IME	NEMO 96HD+ (MF96021)	2167 8900 35	Class 0.5S	0-400/5A	10/5/2011 & 2167 8900 35 (1 June 11 - 30 June 11)	9/5/2014	36 months
11	Power meter	Energy consumed	$EL_{PJ,GE,Flare No.1 \& 2}$ (EL2)	$EL_{PJ,GE,Flare No.1 \& 2,y}$	kWh	IME	NEMO 96HD+ (MF96021)	2135 3800 22	Class 0.5S	0-250/5A	10/5/2011 & 2135 3800 22 (1 June 11 - 30 June 11)	9/5/2014	36 months

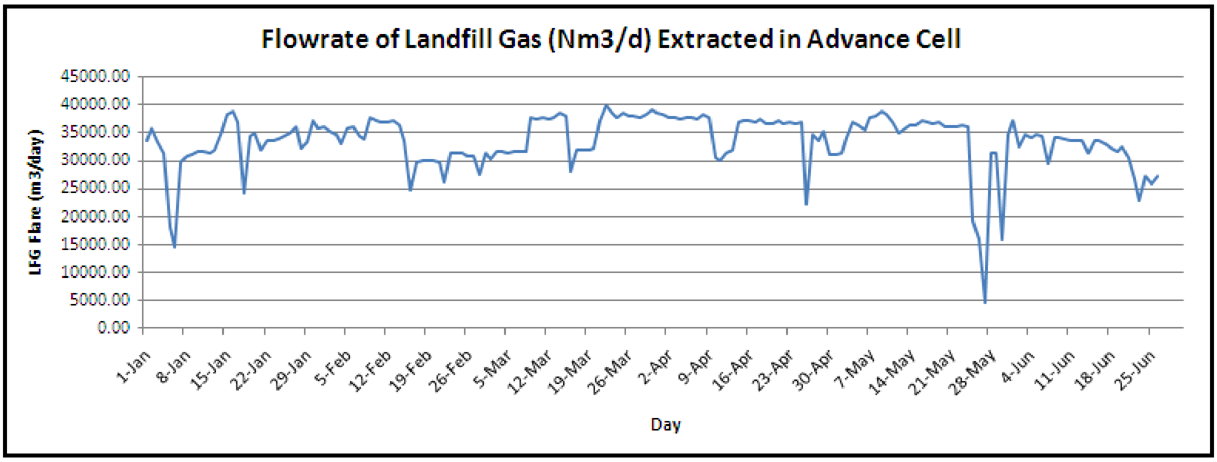
Span Gas			
No	Parameters	Analysis date	Best if used by
1	N_2, CH_4	04/10/2010	04/10/2020
2	N_2, CO_2	04/10/2010	04/10/2020
3	N_2, O_2	04/10/2010	04/10/2020

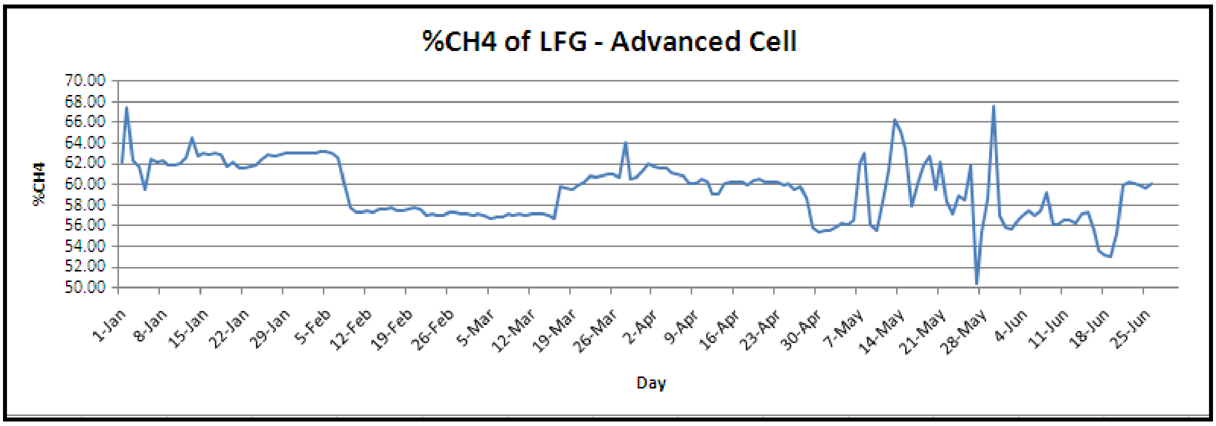
Data Collection (for the whole monitoring period)

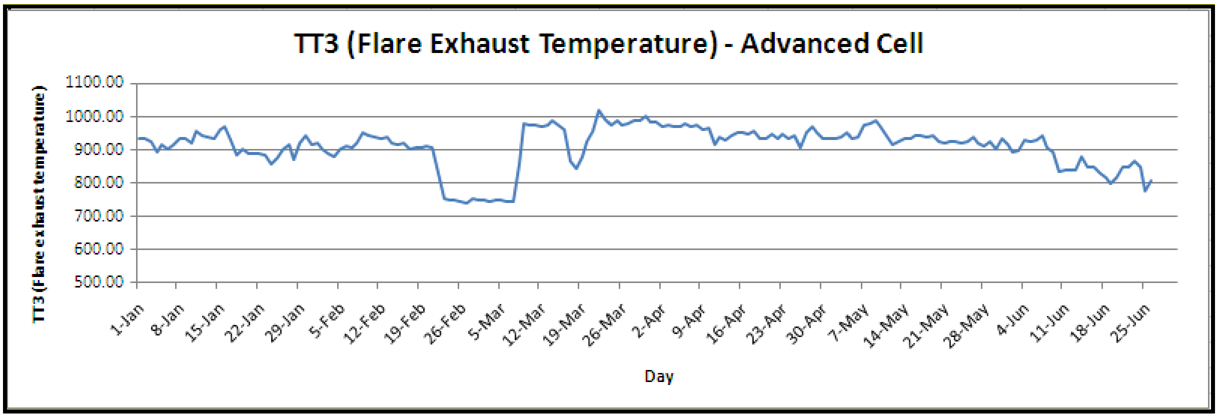
Based on the monitoring plan, key flaring parameters (temperature, pressure, flow of gas, CH_4 concentration in LFG) were continuously monitored and recorded via the data logger at the flare system control room. Continuous flaring data were logged and archived in every 1 minute in the database file. These raw data were compiled and analysed for the calculation of Certified ERs (CERs).

Data recorded for key parameters are compiled and presented below:

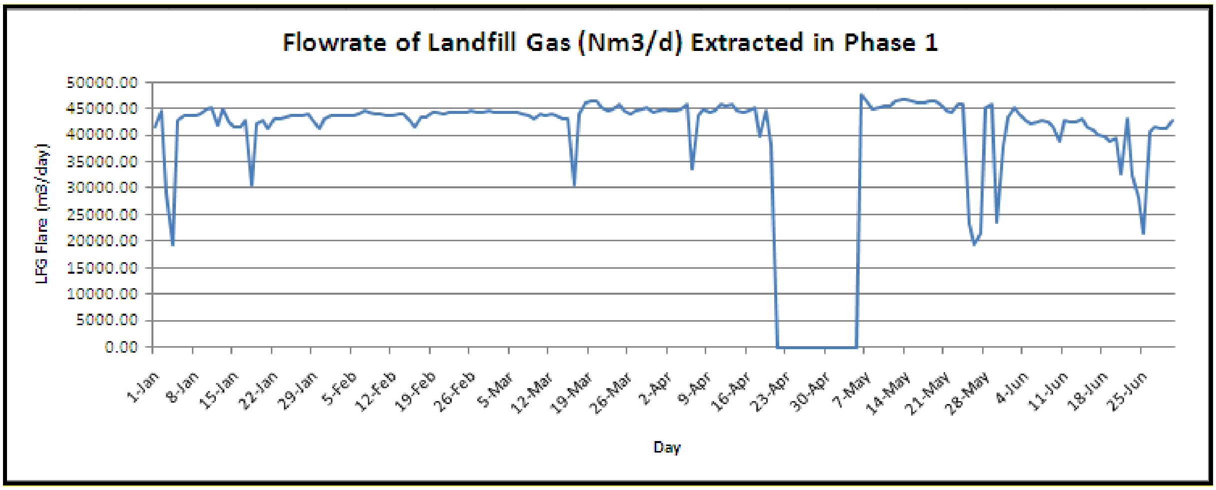
Flare No.1

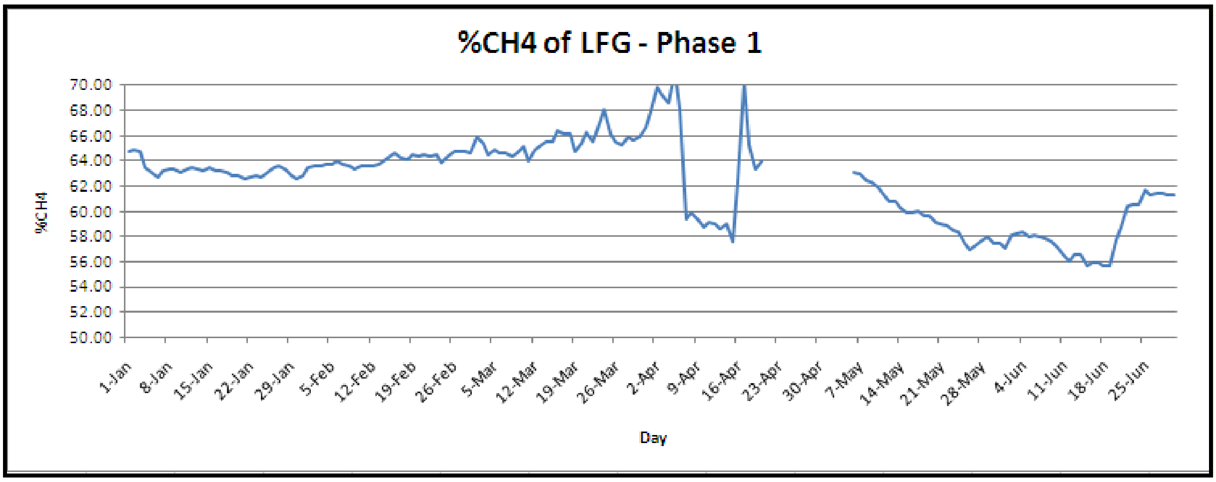


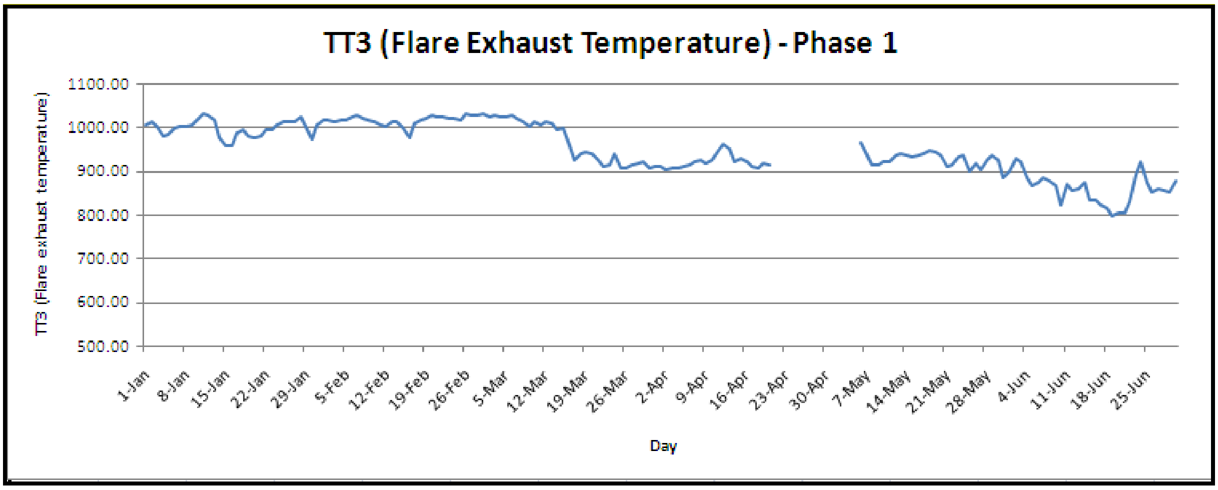




Flare No. 2







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 as well as electricity generated were recorded in daily monitoring log sheets on a daily basis and compiled in MS Excel format weekly.

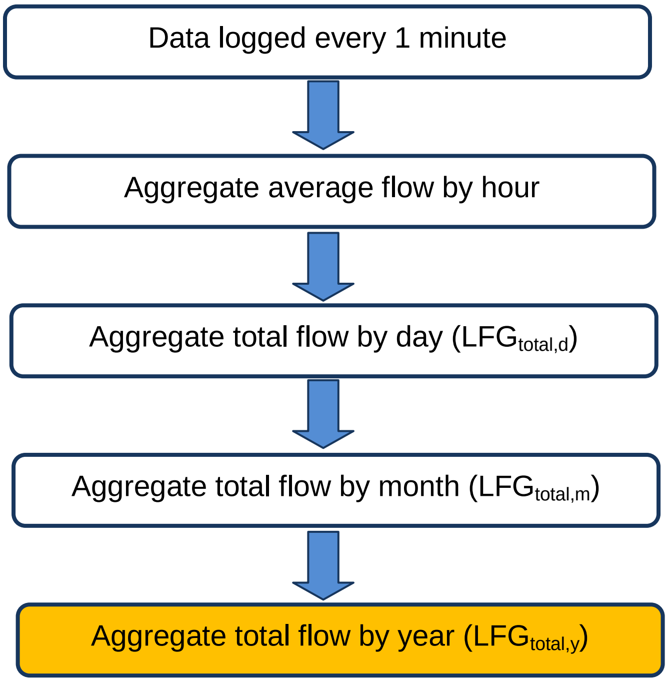
Data Processing

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 Microsoft Access) was developed by the CDM consultant to process continuous 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)



Hour	LFG-Total LFG Flow (m^3)
00:00-01:00	780
01:01-02:00	880
02:01-03:00	950
…..	
Total (day)	22,000

Figure 10: 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.

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) (weekly)	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., C-7-2, Wisma Goshen, Plaza Pantai, 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:

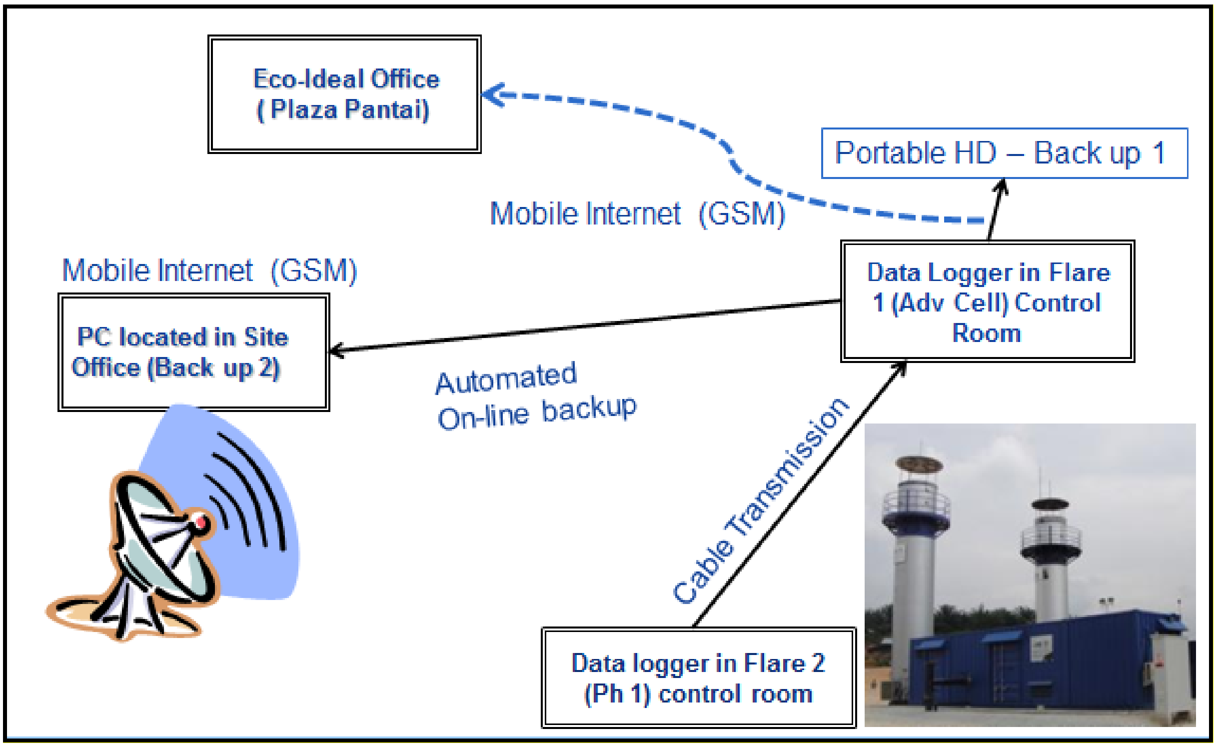


Figure 11: Automatic Data Back-up for Flaring System at BTSL

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 Monitoring Audit Plan and Procedures (October 2009). An independent audit relevant to the 3rd monitoring period was conducted by the consultant (Eco-Ideal Consulting Sdn. Bhd.):

- 1st Internal Audit (Audit No. 6) – 26th May 2011

The independent audit served as an important QC measure to ensure that all the monitoring required are done in accordance to the plan. Through these audits, 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 Monitoring Plan.

Training on data recording of newly installed power meters was conducted on 26th May 2011 at the Bukit Tagar project site office. The participants were staff from the BTSL's monitoring team which consisted of the Senior Landfill Operation Manager, CDM Manager, supervisors, chargeman and general workers.

The objective of the training was to ensure that all the staff is provided with the needed knowledge and skills to undertake their roles efficiently and perform manual data recording according to the CDM Monitoring Plan.

Data recording and documentation and the updates from the monitoring manual were discussed and elaborated during the training.

The staff has also attended other technical/operational training provided by the suppliers/contractors as listed below:

No	Description	Date	No. of participants
1	Gas De-Humidifier Unit (GDU) Training by SPE	1st March 2011	9
2	Landfill Gas Gen-Set Training by SPE	3rd March 2011	10
3	LV Panel Training by SCG	31st March 2011	5
4	Gen-Set Control Panel	2nd June 2011	10

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**Regulatory requirement relating to landfill gas projects**
Data unit:	-
Description:	Regulatory requirement relating to landfill gas projects
Source of data used:	There is no regulatory requirement to recovery 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 (28th August 2009-28th February 2010).
Value (s):	NA
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	NA

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential (GWP) for CH_4
Source of data used:	Intergovernmental Panel on Climate Change (IPCC), Technical Summary, Working Group 1, pg. 33 The default value given by IPCC 2006 guideline for GWP of CH_4
Value (s):	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	NA

Data / Parameter:	**D_{CH4}**
Data unit:	t_{CH4}/m^3_{CH4}
Description:	CH_4 density at standard temperature and pressure
Source of data used:	ACM0001 – “Consolidated baseline and monitoring methodology for landfill gas project activities” (Version 8)
Value (s):	0.0007168

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculation
Additional Comment:	-

Data / Parameter:	**Φ**
Data unit:	-
Description:	Model correction factor to account for model uncertainties
Source of data used:	This uncertainty factor was adopted and the value of 0.9 based on recommendations in the "Tool to determine methane emissions avoided from dumping waste at solid waste disposal site".
Value (s):	0.9
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

Data / Parameter:	**f**
Data unit:	-
Description:	Fraction of methane captured at the SWDS and flared, combusted or used in another manner
Source of data used:	There are no methane flaring, combustion or other usage of the methane in the baseline scenario
Value (s):	0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

Data / Parameter:	**OX**
Data 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 used:	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):	0.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation

Additional Comment:	-

Data / Parameter:	**F**
Data unit:	%
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	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):	0.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

Data / Parameter:	**DOC_f**
Data unit:	%
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	This value was applied based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value (s):	0.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

Data / Parameter:	**MCF**
Data unit:	-
Description:	Methane Correction Factor
Source of data used:	This value was applied based on the recommendation of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories. The Bukit Tagar Sanitary Landfill site is a fully anaerobic managed solid waste disposal site. 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 and compaction as well as levelling were practiced based on international landfill operational practices.
Value (s):	1.0
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

Data / Parameter:	DOC_j
Data unit:	-
Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	The above values were adopted from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 2.4)
Value (s):	The following values for the different waste fraction (types) were applied: (see table below)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	-

DOC_j		
Waste type j	**DOC_j (% wet basis)**	**DOC_j (% dry basis)**
Wood and wood products	**43**	50
Pulp, paper and cardboard (other than sludge)	**40**	44
Food, food waste, beverages and tobacco (other than sludge)	**15**	38
Textiles	**24**	30
Garden, yard and park waste	**20**	49
Glass, plastic, metal, other inert waste	**0**	0
Nappies	**24**	60

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

Value (s):	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<1000mm)	Wet (MAP>1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0/06	0.045	**0.07**
	Wood, wood products and straw	0.02	0.03	0.025	**0.035**
Moderately degrading	Other (non-food) organic putrescrible 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**

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation
Additional Comment:	The project site is located in the State of Selangor, Malaysia. The climate is tropical with an annual mean 24hr temperature of approximately 27°C and annual mean precipitation of around 2700mm. These values were long-term averages documented in the EIA report prepared for the landfill in 2005. Thus, the K-values for tropical temperature and wet climate were used.

Data / Parameter:	**TDL_y**
Data unit:	-
Description:	Average technical transmission and distribution losses for providing electricity to the grid in year y
Source of data used:	Default values from TNB Report, 2007
Value applied:	0.1
Indicate what the data are used for (Baseline/	Project emission calculation

Project/ Leakage emission reduction calculations)	
Additional comment:	TDL_y should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to.

D.2. Data and parameters monitored

Data / Parameter:	**$LFG_{total,y}$**
Data 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 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.
Value (s) of monitored parameter:	The total LFG captured was the same as the total LFG flared during the first 5 months of the monitoring period (at normal temperature and pressure) as the gas engine has not yet been installed. Thus, no gas is used for power generation. Starting from June 2011, the gas engine has commenced and a part of the gas was used for power generation.
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculation

Months	Flare No. 1 Value (Nm^3)	Flare No. 2 Value (Nm^3)
January 11	1,005,003	1,285,238
February 11	919,852	1,228,093
March 11	1,094,354	1,364,147
April 11	1,031,659	874,246
May 11	1,020,757	1,089,439
June 11	943,410	1,164,361
Total	**6,015,035**	**7,005,523**

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(see table below)

Item	Flare No. 1 Description		Flare No. 2 Description	
	1 Jan - 27 Apr 11	28 Apr - 30 June 11	1 Jan - 27 Apr 11	28 Apr - 30 June 11
Type	Differential Pressure Transmitter	Differential Pressure Transmitter	Differential Pressure Transmitter	Differential Pressure Transmitter
Accuracy class	± 1%	± 1%	± 0.5%	± 0.5%
Serial No.	4972946 / FT119 (8102101)	4972946 / FT119 (8102101)	5476626 / FT141 (10031702)	5476626 / FT141 (10031702)
Calibration frequency	2 years	2 years	2 years	2 years
Date of last calibration	28/4/2010	28/4/2011	7/4/2010	28/4/2011
Validity	2 years	2 years	2 years	2 years

Measuring/ Reading/ Recording frequency:	Measured continuously with a flow meter. Data was aggregated on both monthly and yearly basis
Calculation method (if applicable)	NA
QA/QC procedures to be applied:	Flow meters were tested, calibrated and maintained regularly.

Data / Parameter:	**$LFG_{flare,y}$**
Data 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.

<table>
<tr><td>Value (s) of monitored parameter:</td><td>

Months	Flare No. 1 Value (Nm_3)	Flare No. 2 Value (Nm_3)
January 11	1,005,003	1,285,238
February 11	919,852	1,228,093
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April 11	1,031,659	874,246
May 11	1,020,757	1,089,439
June 11	943,410	1,164,361
Total	**6,015,035**	**7,005,523**

</td></tr>
<tr><td>Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline and Project emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>

Item	Flare No. 1 Description		Flare No. 2 Description	
	1 Jan - 27 Apr 11	28 Apr - 30 June 11	1 Jan - 27 Apr 11	28 Apr - 30 June 11
Type	Differential Pressure Transmitter	Differential Pressure Transmitter	Differential Pressure Transmitter	Differential Pressure Transmitter
Accuracy class	± 1%	± 1%	± 0.5%	± 0.5%
Serial No.	4972945 / FT120 (8102102)	4972945 / FT120 (8102102)	5476627 / FT140 (10031701)	5476627 / FT140 (10031701)
Calibration frequency	2 years	2 years	2 years	2 years
Date of last calibration	28/4/2010	28/4/2011	7/4/2010	28/4/2011
Validity	2 years	2 years	2 years	2 years

</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Measured continuously with flow meter. Data was aggregated on both monthly and yearly basis</td></tr>
<tr><td>Calculation method (if applicable)</td><td>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.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>Flow meters were tested, calibrated and maintained regularly.</td></tr>
</table>

Data / Parameter:	**$LFG_{electricity,y}$**
Data unit:	m^3
Description:	Amount of landfill gas combusted in power plant (gas engines) at normal temperature and pressure

Measured/ Calculated/ Default:	Measured
Source of data:	Continuous measurement by flow meter during operation of project activity.
Value (s) of monitored parameter:	The gas engine was only commenced in June 2011. **Months** / **Flare No. 2 Value (Nm_3)** January 11: 0 February 11: 0 March 11: 0 April 11: 0 May 11: 0 June 11: 202,655 **Total**: **202,655**
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	**Item** / **Flare No. 2 Description 1 June - 30 June 11** Type: Differential Pressure Transmitter Accuracy class: ± 0.5% Serial No.: 5490821 / FT161 (11011001) Calibration frequency: 2 years Date of last calibration: 20/1/2011 Validity: 2 years
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 to be applied:	Flow meters were tested, calibrated and maintained regularly.

Months	Flare No. 2 Value (Nm_3)
January 11	0
February 11	0
March 11	0
April 11	0
May 11	0
June 11	202,655
Total	**202,655**

Item	Flare No. 2 Description
	1 June - 30 June 11
Type	Differential Pressure Transmitter
Accuracy class	± 0.5%
Serial No.	5490821 / FT161 (11011001)
Calibration frequency	2 years
Date of last calibration	20/1/2011
Validity	2 years

Data / Parameter:	**$PE_{flare,y}$**
Data unit:	tCO_2e
Description:	Project emissions from flaring of the residual gas stream in year y
Measured/ Calculated/ Default:	Calculated
Source of data:	Calculated as per the "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13, pg. 10) 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.

Value (s) of monitored parameter:	**Months** / **Flare No. 1 Value (tCO_2e)** / **Flare No. 2 Value (tCO_2e)** January 11 / 987.24 / 1260.34 February 11 / 849.04 / 1183.81 March 11 / 996.08 / 1371.28 April 11 / 990.25 / 882.81 May 11 / 950.01 / 1019.82 June 11 / 844.79 / 1060.44 **Total** / **5617.41** / **6778.50**
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Refer to $\mathbf{T_{flare}}$ below
Measuring/ Reading/ Recording frequency:	As per the "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13, pg. 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).
Calculation method (if applicable)	As per the "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13, pg. 10)
QA/QC procedures to be applied:	As per the "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13, pg. 10)

Months	Flare No. 1 Value (tCO_2e)	Flare No. 2 Value (tCO_2e)
January 11	987.24	1260.34
February 11	849.04	1183.81
March 11	996.08	1371.28
April 11	990.25	882.81
May 11	950.01	1019.82
June 11	844.79	1060.44
Total	**5617.41**	**6778.50**

Data / Parameter:	$\mathbf{w_{CH4}}$
Data unit:	m^3 CH4 / m^3 LFG
Description:	Fraction of CH_4 in LFG
Measured/ Calculated/ Default:	Measured
Source of data:	Continuous measurement by using a multi-gas analyser. 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.

<table>
<tr><td>Value (s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Flare No. 1 Value (% wet basis)</th><th>Flare No. 2 Value (% wet basis)</th></tr>
<tr><td>January 11</td><td>62.52%</td><td>63.26%</td></tr>
<tr><td>February 11</td><td>58.90%</td><td>64.04%</td></tr>
<tr><td>March 11</td><td>58.80%</td><td>65.49%</td></tr>
<tr><td>April 11</td><td>60.02%</td><td>63.54%</td></tr>
<tr><td>May 11</td><td>59.22%</td><td>59.66%</td></tr>
<tr><td>June 11</td><td>57.42%</td><td>58.30%</td></tr>
<tr><td>Average</td><td>59.48%</td><td>62.38%</td></tr>
</table>
</td></tr>
<tr><td>Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline and Project emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>
<table>
<tr><th rowspan="2">Item</th><th colspan="2">Flare No. 1 Description</th></tr>
<tr><th>1 Jan - 27 Apr 11</th><th>28 Apr - 30 June 11</th></tr>
<tr><td>Type</td><td>Infra-Red Gas Monitor</td><td>Infra-Red Gas Monitor</td></tr>
<tr><td>Accuracy class</td><td>± 2%</td><td>± 2%</td></tr>
<tr><td>Serial No.</td><td>28931</td><td>28931</td></tr>
<tr><td>Calibration frequency</td><td>Annually</td><td>Annually</td></tr>
<tr><td>Date of last calibration</td><td>28/4/2010</td><td>28/4/2011</td></tr>
<tr><td>Validity</td><td>1 year</td><td>1 year</td></tr>
</table>
<table>
<tr><th rowspan="2">Item</th><th colspan="3">Flare No. 2 Description</th></tr>
<tr><th>1 Jan - 9 Mar or 18 Apr 11</th><th>9 Mar or 18 Apr - 5 May 11</th><th>5 May - 30 June 11</th></tr>
<tr><td>Type</td><td>Infra-Red Gas Monitor</td><td>Infra-Red Gas Monitor</td><td>Infra-Red Gas Monitor</td></tr>
<tr><td>Accuracy class</td><td>± 2%</td><td>± 2%</td><td>± 2%</td></tr>
<tr><td>Serial No.</td><td>31453</td><td>30548</td><td>32560</td></tr>
<tr><td>Calibration frequency</td><td>Annually</td><td>Annually</td><td>Annually</td></tr>
<tr><td>Date of last calibration</td><td>9/11/2010</td><td>9/3/2011</td><td>5/5/2011</td></tr>
<tr><td>Validity</td><td>1 year</td><td>1 year</td><td>1 year</td></tr>
</table>
</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>The CH_4 fraction were measured continuously with a multi-gas analyzer</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Raw data logged at 1 minute’s interval was used to compute the daily average readings.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>The CH_4 gas analyser was checked and calibrated regularly according to the manual given by the manufacturer.</td></tr>
</table>

Data / Parameter:	**T ($T_{TT1,F1}$ and $T_{TT1,F2}$)**
Data 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 of the flares, i.e. Flare No.1 and Flare No.2. Therefore, 2 sets of equipment were used for the monitoring period.
Value (s) of monitored parameter:	(see table below)
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(see table below)
Measuring/ Reading/ Recording frequency:	Measured continuously by temperature meter

Value (s) of monitored parameter:

Months	Flare No. 1 Value (°C)	Flare No. 2 Value (°C)
January 11	55.93	47.90
February 11	61.91	50.33
March 11	63.18	47.73
April 11	63.70	46.41
May 11	60.27	47.25
June 11	53.93	45.51
Average	**59.82**	**47.52**

Monitoring equipment:

Item	Flare No. 1 Description		Flare No. 2 Description	
	1 Jan – 27 Apr 11	28 Apr - 30 June 11	1 Jan – 27 Apr 11	28 Apr - 30 June 11
Type	Temperature Transmitter	Temperature Transmitter	Temperature Transmitter	Temperature Transmitter
Accuracy class	± 0.5%	± 0.5%	± 0.5% of span	± 0.5% of span
Serial No.	B224836437	B224836437	B839917437	B839917437
Calibration frequency	Annually	Annually	Annually	Annually
Date of last calibration	28/4/2010	28/4/2011	18/5/2010	28/4/2011
Validity	1 year	1 year	1 year	1 year

Calculation method (if applicable)	Raw data logged at 1 minute's interval was used to compute the daily average readings.
QA/QC procedures to be applied:	The temperature transmitter was calibrated regularly according to the manual given by the manufacturer.

Data / Parameter:	**P ($P_{PT2,F1}$ and $P_{PT2,F2}$)**
Data unit:	Pa
Description:	Pressure of the LFG
Measured/ Calculated/ Default:	Measured
Source of data:	Continuous measurement by pressure transmitter. 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.
Value (s) of monitored parameter:	(see table below)
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculation
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	(see table and note below)

Months	Flare No. 1 Value (kPa)	Flare No. 2 Value (kPa)
January 11	18.75	13.74
February 11	22.58	14.53
March 11	24.23	12.92
April 11	24.23	11.36
May 11	21.84	11.84
June 11	25.22	10.41
Average	**22.81**	**12.47**

Item	Flare No. 1 Description		
	1 Jan - 27 Apr 11	28 Apr – 22 June 11	22 June - 30 June 11
Type	Pressure Transmitter	Pressure Transmitter	Pressure Transmitter
Accuracy class	± 0.25%	± 0.25%	± 0.25%
Serial No.	01873654	01873654	02255815
Calibration frequency	Annually	Annually	Annually
Date of last calibration	28/4/2010	28/4/2011	24/6/2010
Validity	1 year	1 year	1 year

- *The maximum permissible error for PT_2 (+0.25%) was applied starting from 23 June - 30 June 2011 as a conservative approach. The impact of applying these errors to the flow normalisation is negligible.*

	<table><tr><th rowspan="2">Item</th><th colspan="2">Flare No. 2 Description</th></tr><tr><th>1 Jan - 27 Apr 11</th><th>28 Apr - 30 June 11</th></tr><tr><td>Type</td><td>Pressure Transmitter</td><td>Pressure Transmitter</td></tr><tr><td>Accuracy class</td><td>± 0.25%</td><td>± 0.25%</td></tr><tr><td>Serial No.</td><td>5584784</td><td>5584784</td></tr><tr><td>Calibration frequency</td><td>Annually</td><td>Annually</td></tr><tr><td>Date of last calibration</td><td>17/5/2010</td><td>28/4/2011</td></tr><tr><td>Validity</td><td>1 year</td><td>1 year</td></tr></table>
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 to be applied:	The meter was checked and calibrated regularly according to the manual given by the manufacturer.

Data / Parameter:	**EL_{LFG}**
Data unit:	MWh
Description:	Net amount of electricity generated using landfill gas
Measured/ Calculated/ Default:	Measured
Source of data:	Data as measured by the electricity meter
Value (s) of monitored parameter:	<table><tr><th>Months</th><th>Flare No. 2 Value (MWh)</th></tr><tr><td>January 11</td><td>0</td></tr><tr><td>February 11</td><td>0</td></tr><tr><td>March 11</td><td>0</td></tr><tr><td>April 11</td><td>0</td></tr><tr><td>May 11</td><td>0</td></tr><tr><td>June 11</td><td>386.60</td></tr><tr><td>Total</td><td>386.60</td></tr></table>
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculation

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<table><tr><th>Item</th><th>Flare No. 2 Description From 1 June 11 – 30 June 11</th></tr><tr><td>Type</td><td>Power Meter</td></tr><tr><td>Accuracy class</td><td>Class 0.5S</td></tr><tr><td>Serial No.</td><td>210225256</td></tr><tr><td>Calibration frequency</td><td>Annually</td></tr><tr><td>Date of last calibration</td><td>15/7/2010</td></tr><tr><td>Validity</td><td>1 year</td></tr></table>
Measuring/ Reading/ Recording frequency:	Measured continuously with an electricity meter
Calculation method (if applicable)	NA
QA/QC procedures to be applied:	The electricity meter was checked and calibrated regularly according to the manual given by the manufacturer.

Data / Parameter:	**$CEF_{elec,PR,y}$**
Data unit:	tCO_2/MWh
Description:	Carbon emission factor of electricity
Measured/ Calculated/ Default:	Calculated
Source of data:	Grid connected baseline for Peninsular Malaysia for 2008 by Malaysian Energy Centre (http://cdm.eib.org.my/subindex.php?menu=24&article=1052)
Value (s) of monitored parameter:	**0.672** based on the latest released grid connected baseline emission factor for Peninsular Malaysia for 2008
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	To be re-calculated with the latest release of grid connected baseline emission factor. The emission factor for year 2008 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. A confirmation via e-mail was received from the Malaysian Green Technology Corporation (MGTC) on 22nd January 2011 confirming the latest available emission factor available in Malaysia. Referring to page 6 of the *“Tool to calculate the emission factor*

	for an electricity system" Version 2, EB50, if the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year y-2 may be used. In other words, for year 2011, the data for 2009 (y-2) can be used for our case.
Calculation method (if applicable)	The $\mathbf{CEF}_{elec,PR,y}$ was calculated based on the "Tool to calculate the emission factor for an electricity system" (Version 2, EB50)
QA/QC procedures to be applied:	NA

Data / Parameter:	**Operation of the energy plant (t)**
Data unit:	Hours
Description:	Operation of the energy plant
Measured/ Calculated/ Default:	Measured
Source of data:	Based on actual documented operating hours
Value (s) of monitored parameter:	(see table below)
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Gas Engine TEM Evo System
Measuring/ Reading/ Recording frequency:	This is monitored annually using a run time meter to ensure methane destruction is claimed for methane used in the electricity plant when it is operational
Calculation method (if applicable)	NA
QA/QC procedures to be applied:	The run time meter was checked and calibrated regularly according to the manual given by the manufacturer.

Months	Operating time (hr)
January 11	0
February 11	0
March 11	0
April 11	0
May 11	0
June 11	432
Total	**432**

Data / Parameter:	$\mathbf{EL}_{PJ,y}$
Data unit:	MWh
Description:	Quantity of electricity consumed by project activity
Measured/ Calculated/ Default:	Measured

<table>
<tr><td>Source of data:</td><td>Based on continuous measurement by sealed electricity meter installed.

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.</td></tr>
<tr><td>Value (s) of monitored parameter:</td><td>
<table>
<tr><th>Months</th><th>Flare No. 1 Value (MWh)</th><th>Flare No. 2 Value (MWh)</th></tr>
<tr><td>January 11</td><td>14.36</td><td>13.76</td></tr>
<tr><td>February 11</td><td>17.07</td><td>14.65</td></tr>
<tr><td>March 11</td><td>21.74</td><td>17.01</td></tr>
<tr><td>April 11</td><td>19.03</td><td>24.97</td></tr>
<tr><td>May 11</td><td>17.43</td><td>12.66</td></tr>
<tr><td>Total</td><td>89.63</td><td>83.05</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>June 11 (01-20 June 11)</td><td colspan="2">14.45</td></tr>
<tr><td>June 11 (21 – 30 June 11)</td><td colspan="2">17.66</td></tr>
<tr><td>Total</td><td colspan="2">204.79</td></tr>
</table>
</td></tr>
<tr><td>Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Project emission calculation</td></tr>
</table>

<table>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>

Item	Flare No. 1 Description		Flare No. 2 Description
	1 Jan - 5 May 11	6 May - 30 June 11	1 Jan - 30 June 11
Type	Analog kWh Meter	Analog kWh Meter	Digital Energy Multimeters
Accuracy class	Class 2	Class 2	± 1%
Serial No.	8383258	8383258	4309
Calibration frequency	Annually	Annually	36 months
Date of last calibration	25/4/2010	6/5/2011	15/10/2009
Validity	1 year	1 year	3 years

**The maximum permissible error for EL_{PJ} (+2%) was applied starting from 25 April 2011 – 05 May 2011 as a conservative approach.*

Item	Project Activity	Flare No. 1 & 2 from GE
	1 June - 30 June 11	1 June - 30 June 11
Type	Power Meter	Power Meter
Accuracy class	Class 0.5S	Class 0.5S
Serial No.	2167 8900 35	2135 3800 22
Calibration frequency	36 months	36 months
Date of last calibration	10/5/2011	10/5/2011
Validity	3 years	3 years

</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Continuous measurement</td></tr>
<tr><td>Calculation method (if applicable)</td><td>NA</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>The electricity meter was tested and calibrated as per the specifications prescribed by the manufacturer.</td></tr>
</table>

Data / Parameter:	$T_{flare,y}$
Data unit:	°C
Description:	Temperature in exhaust gas of the enclosed flare
Measured/ Calculated/ Default:	Measured
Source of data:	Continuous measurement by temperature meter. 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.

<table>
<tr><td>Value (s) of monitored parameter:</td><td>

Months	Flare No. 1 Value (°C)	Flare No. 2 Value (°C)
January 11	914.11	998.61
February 11	875.86	1017.17
March 11	910.49	968.81
April 11	950.26	921.55
May 11	935.42	928.12
June 11	856.13	860.83
Average	**907.05**	**949.18**

</td></tr>
<tr><td>Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Project emission calculation</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)</td><td>

Item	Flare No.1 Description		Flare No. 2 Description	
	1 Jan – 7 Mar 11	8 Mar - 30 June 11	1 Jan – 27 Apr 11	28 Apr - 30 June 11
Type	Temperature Transmitter	Temperature Transmitter	Temperature Transmitter	Temperature Transmitter
Accuracy class	± 0.5%	0.1°C (resolution)	± 0.5% of span	± 0.5% of span
Serial No.	B123070037	T11-0396-1	B838901937	B838901937
Calibration frequency	Annually	Annually	Annually	Annually
Date of last calibration	15/6/2010	3/3/2011	18/5/2010	28/4/2011
Validity	1 year	1 year	1 year	1 year

</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>The enclosed flare is monitored continuously by a temperature meter.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>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” (EB28, Annex 13)</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>The temperature meter was tested and calibrated as per the specifications prescribed by the manufacturer.</td></tr>
</table>

Data / Parameter:	**Relevant policies and circumstances at the beginning of each crediting period**
Data unit:	NA
Description:	
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 a crediting period.
Indicate what the date are used for (Baseline/ Project/ Leakage emission calculations)	NA
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	To be checked at the beginning of a crediting period.
Calculation method (if applicable)	NA
QA/QC procedures to be applied:	NA

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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

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

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

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

	$MD_{flared,y} = \{LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4})$								$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4}$			$MD_{project,y}$
Month	Quantity of Flare No.1 flare no 1,y (Nm3)	Methane average fraction Flare No.1 WCH4 (% wet basis)	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 Landfill Gas Fed into the Electricity Generator No. 1 LFG electricity,y (m^3 LFG)	Average methane fraction of the landfill gas as measured WCH4 (% wet basis)	Quantity of methane destroyed by generation of electricity MD electricity,y (tCH4)	Quantity of methane that would have been destroyed MD project,y (tCH4)
Jan-11	1,005,003	0.63	0.0007168	450.37	21	9457.8	987.24	403.36	0.00	0.63	0.00	403.36
Feb-11	919,852	0.59	0.0007168	388.35	21	8155.4	849.04	347.92	0.00	0.59	0.00	347.92
Mar-11	1,094,354	0.59	0.0007168	461.24	21	9686.1	996.08	413.81	0.00	0.59	0.00	413.81
Apr-11	1,031,659	0.60	0.0007168	443.84	21	9320.6	990.25	396.69	0.00	0.60	0.00	396.69
May-11	1,020,757	0.59	0.0007168	433.27	21	9098.6	950.01	388.03	0.00	0.59	0.00	388.03
Jun-11	943,410	0.58	0.0007168	394.25	21	8279.2	844.79	354.02	0.00	0.57	0.00	354.02

Note: During the breakdown or installation of CH_4 analyser, TT3 transmitter and PT2 transmitter, down time of the system were noticed. The breakdown or installation events for CH_4 analyser have occurred on 16th March (7:34pm – 10:28pm). The breakdown or installation events for TT3 transmitter have occurred on 2^{nd} March (9:16am – 10:12am) and 8^{th} March (11:14am – 12:28pm). The breakdown or installation events for PT2 transmitter have occurred on 22^{nd} June (7:12am – 9:24am).All the data recorded during these breakdown events for CH_4 analyser and TT3 transmitter were excluded from the calculation of CER.

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 to Flare No.2 flare no.2,y (Nm3)	Methane average fraction Flare No.2 WCH4 (% wet basis)	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 Electricity Generator No. 1 LFG electricity,y (m³ LFG)	Average methane fraction of the landfill gas as measured WCH4 (% wet basis)	Quantity of methane destroyed by generation of electricity MD electricity,y (tCH4)	Quantity of methane that would have been destroyed MD project,y (tCH4)
Jan-11	1,285,238	0.63	0.0007168	582.83	21	12239.4	1260.34	522.81	0.00	0.63	0.00	522.81
Feb-11	1,228,093	0.64	0.0007168	563.72	21	11838.1	1183.81	507.35	0.00	0.64	0.00	507.35
Mar-11	1,364,147	0.65	0.0007168	640.39	21	13448.2	1371.28	575.09	0.00	0.65	0.00	575.09
Apr-11	874,246	0.64	0.0007168	398.21	21	8362.4	882.81	356.17	0.00	0.64	0.00	356.17
May-11	1,089,439	0.60	0.0007168	465.87	21	9783.3	1019.82	417.31	0.00	0.60	0.00	417.31
Jun-11	1,164,361	0.58	0.0007168	486.63	21	10219.1	1060.44	436.13	202,655	0.58	84.70	520.82

Note: During the breakdown of CH_4 analyser, down time of the system was noticed. The breakdown event for CH_4 analyser has occurred on 28th April (3:22am – 3:39am) and 29th April (8:28pm – 10:27pm). All the data recorded during the breakdown event for CH_4 analyser were excluded from the calculation of CER.

Determination of BE_y for Flare No.1

	$(MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$	$EL_{LFG,y} \cdot CEF_{elec,BL,y}$			Bey Flare No.1
Month	Emissions from Flare No.1 (tCO2e)	Total electricity generated from Flare No.2 (EL4) EL,y (MWh)	CoEF for electricity Flare No.2 CEF electricity,y	Baseline Emission from electricity generation Flare No.2 (tCO2e)	Total Baseline Emissions Flare No.1 (tCO2e)
Jan-11	8470.55	0.00	0.672	0.00	8,470.55
Feb-11	7306.32	0.00	0.672	0.00	7,306.32
Mar-11	8690.07	0.00	0.672	0.00	8,690.07
Apr-11	8330.40	0.00	0.672	0.00	8,330.40
May-11	8148.56	0.00	0.672	0.00	8,148.56
Jun-11	7434.45	0.00	0.672	0.00	7,434.45

Determination of BE_y for Flare No.2

	$(MD_{project,y} - MD_{BL,y}) * GWP_{CH4}$ D_{CH4} PE_j $EL_{LFG,y} \cdot CEF_{elec,BL,y}$				Bey Flare No.2
Month	Emissions from Flare No.2 (tCO2e)	Total electricity generated from Flare No.2 (EL4) EL,y (MWh)	CoEF for electricity Flare No.2 CEF electricity,y	Baseline Emission from electricity generation Flare No.2 (tCO2e)	Total Baseline Emissions Flare No.2 (tCO2e)
Jan-11	10979.07	0.00	0.672	0.00	10,979.07
Feb-11	10654.28	0.00	0.672	0.00	10,654.28
Mar-11	12076.88	0.00	0.672	0.00	12,076.88
Apr-11	7479.58	0.00	0.672	0.00	7,479.58
May-11	8763.49	0.00	0.672	0.00	8,763.49
Jun-11	10937.31	397.55	0.672	267.16	11,204.46

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 the natural gas pipeline.
2. For this project, $MD_{BL,y}$ is zero since there are no destroy or combustion of CH_4 today due to the regulatory and 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 CH_4 for LFG is obtained from ACM0001, Version 8.0, page 14.
5. The emission factor of 2008 was applied as this was the latest released data. Refer to the reason and justification in page 41 above.

Total BE_y

Month	Bey Flare No.1	Bey Flare No.2	Total Bey
Jan-11	8471	10,979	19,449
Feb-11	7306	10,654	17,960
Mar-11	8690	12,077	20,766
Apr-11	8330	7,480	15,809
May-11	8149	8,763	16,912
Jun-11	7435	11,204	18,639
Total	48,381	61,158	109,535

E.2. Project emissions calculation

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

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

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

Month	Electricity consumed by project activity Flare No.1 from grid ELPJ,grid,flare no.1,y (MWh)	Electricity consumed by project activity from grid Flare No.2 ELPJ,grid,flare no.2,y (MWh)	Electricity consumed by project activity from grid Gas engine (EL1) ELPJ,grid,gas engine,y (MWh)	Total Electricity consumed by project activity ELPJ,total,y (MWh)	Coefficient for grid electricity EF grid,y	Transmission and Distribution Losses TDL,y	Total Project Emission from project activity (tCO2e)
Jan-11	14.36	13.76	0.00	28.12	0.672	0.1	20.79
Feb-11	17.07	14.65	0.00	31.72	0.672	0.1	23.45
Mar-11	21.74	17.01	0.00	38.75	0.672	0.1	28.65
Apr-11	24.12	24.97	0.00	49.09	0.672	0.1	36.28
May-11	12.34	12.66	0.00	25.00	0.672	0.1	18.48
Jun-11		32.12		32.12	0.672	0.1	23.74

For this project, the following applies:

1. $PE_{fc,y}$ is zero as no heat of fossil fuel is used to generate electricity for this project.
2. The grid connected baseline for Peninsular Malaysia for 2008 was applied to this project and the $EF_{BL,ELy}$ calculated was 0.672tCO_2/MWh (http://cdm.eib.org.my/subindex.php?menu=24&article=1052).
3. TDL = 10% was adopted as stated in the PDD, page 35 (TNB Annual Report 2007) http://announcements.bursamalaysia.com/EDMS%5Csubweb.nsf/LsvAllByID/8B0DC73587EFBC114825750B0033ED71?OpenDocument)
4. The emission factor of 2008 was applied as this was the latest released data. Refer to the reason and justification in page 41 above.

E.3.	Leakage calculation

No leakage is applicable to this project.

E.4.	Emission reductions calculation / table

The total emission reduction was calculated as follows:

$$ER_y = BE_y - PE_Y$$

Month	Total Bey	Total Pey	Total ER = BEy - PEy
Jan-11	19,449	21	19,428
Feb-11	17,960	24	17,936
Mar-11	20,766	29	20,737
Apr-11	15,809	33	15,776
May-11	16,912	23	16,889
Jun-11	18,639	24	18,615
Total	**109,535**	**154**	**109,381**

Note:
$MD_{thermal}$ and $MD_{pl,y}$ is not relevant for this project because the LFG is not used for heat generation or natural gas distribution.
PE_y is equivalent to $PE_{EC,y}$ only because no fossil fuel or heat is consumed at site. The baseline emission figure has been rounded down while the project emission has been rounded up for conservativeness.

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

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reduction (tCO_2e)	97,634*	109,381

** proportioned for 6 months (January-June 2011) – 195,268 x (6/12)*

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

The total emission reduction claimed was about 10% higher as compared to the value in the ex-ante calculation. This is mainly due to higher methane collection rate achieved as well as the low downtime of flares (actual 97% and 89%).