MONITORING REPORT

Jaroensompong Corporation Rachathewa Landfill Gas to Energy Project

April 2009, Version 1

UNFCCC Reference No. 1413

Monitoring period: 14/03/2008 ~ 31/12/2008

Jaroensompong Corporation
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1. General description of the project activity

1.1. Title of the project activity

Jaroensompong Corporation Rachathewa Landfill Gas to Energy Project
Version 03, Completed on 27/06/2007

1.2. Summary table

The objective of this monitoring report is to calculate the Greenhouse Gas emission reductions from the project activity.

No.	Name of the CDM project activity	Jaroensompong Corporation Rachathewa Landfill Gas to Energy Project
1	UNFCCC Ref. No.	1413
2	Starting date of the project activity	01/08/2004
3	Starting date of the first crediting period	14/03/2008
4	Length of the first crediting period	10 years (fixed crediting period)
5	Period covered by the current monitoring report	14/03/2008 – 31/12/2008 (9 months)
6	Total net emission reductions estimated in the PDD for the first year	71,503 tCO_2/year
7	Total net emission reductions claimed in the current monitoring report	32,231 tCO_2

Item 6 (total net emission reductions estimated in the PDD for the first year) and item 7 (total net emission reductions claimed in the current monitoring report) cannot be compared directly as the former is an estimated value for 12 months while the latter is calculated using monitored values for 9 months.

1.3. Project description

The Rachathewa landfill site is located 30km east of the Bangkok Metropolitan Area

(BMA) and receives approximately 3,500 tons/day or 16,667 cubic meters/day of municipal solid waste (MSW). There are presently no regulatory or contractual requirements for landfill gas (LFG) collection/combustion in Thailand so landfill sites such as Rachathewa are emitting huge quantities of methane gas directly into the atmosphere.

The Project's developer, Jaroensompong Corporation, has installed a LFG collection system and 1MW electricity generator at the Rachathewa site. Recovered LFG is being utilized as a fuel source for the generator. The generated electricity is being sold to the Metropolitan Electricity Authority (MEA) under a power purchase agreement.

The Project is the first in Thailand to utilize LFG for electricity generation on a commercial basis and contributes to sustainable development of the country by mitigating uncontrolled GHG emission from the landfill, preventing on-site fires, controlling the release of volatile organic compounds, reducing undesirable odours, providing greater control of leachate drainage, and physically stabilizing the landfill site. The Project brings the following additional economic, environmental and social benefits:

- Metro-Cat (The authorized caterpillar dealer in Thailand) has transferred LFG generator related technology to Thailand. The company supplied the generator for the Project and, under the contract, is responsible for training staff in generator operation and maintenance.
- The Project promotes most efficient use of local resources, which results in reduction of energy imports.
- Local inhabitant benefit from the improvement of air quality due to lower methane and odour emissions from the landfill.
- The Project has been promoting practical experience in LFG collection and utilization. Local staff has been trained and acquired the skills required to operate LFG collection and utilization equipment.

1.4. Project location

» Host Party

The Kingdom of Thailand

» Region/State/Province

Samuthprakarn

» City/Town/Community

Rachathewa Bangplee

» Detail of Physical Location

The Project is located at the Rachathewa landfill area, about 30 km east of BMA. The area in the vicinity of the landfill is primarily industrial, with numerous heavy industrial compounds and some agricultural and residential establishments. The Rachathewa landfill site occupies some 40 hectares and includes ancillary facilities necessary to support its operations. It also includes a buffer zone around the disposal area. The landfill site has been separated into two sites.

Site 1

Operations commenced on Site 1 in December 1999. The site was capped and closed in November 2001. The area contains approximately 2.5 million tons of newly disposed solid waste and 2.2 million tons of old solid waste relocated from the On-Nuch landfill site,

Site 2

Site 2 commenced operations in December 2001 and was closed in December 2006. It is estimated that this disposal site will contain approximately 6 million tons of solid waste by the end of 2006.

LFG collection and its utilization for electricity generation are implemented at Site 1.

1.5. Documentation

Relevant documents for the registration of the Project can be found from the following website link.

http://cdm.unfccc.int/Projects/DB/DNV-CUK1194442031.0/view

1.6. Implementation and current status of the project activity

The Project has started on August 1, 2004. The construction has completed on June 2005 and the commercial operation has started on March3, 2006. Detail description of the

installed equipment is provided below.

LFG collection system

Jaroensompong Corporation has utilized its waste management experience to design a LFG collection system for the Project based on horizontal lines and wells. Rather than the traditional vertical system for the closed landfill site, the company concluded that the horizontal design technology is more appropriate for the characteristics of Thai MSW and country's climatic conditions. The MSW contains high moisture. During the long rainy season, there is a continuous influx of rainwater into the landfill site. The wells of a vertical system would be prone to flooding under such conditions.

As was mentioned in foregoing section, the Project has been only utilizing LFG from Site 1. LFG is recovered at the outer edges and at the center of the landfill. The collectors include a system for drainage and collection of leachate at the outer edges of the landfill. They are constructed using PVC and HDPE piping to allow for settlement.

The horizontal collectors and other points are connected by laterals to a main header system. This is the area where LFG gas is drawn to under a vacuum created by the blower.

Condensate is removed from the system using a process which begins from the recovery system. Here, sloping laterals and headers are used to provide drainage into condensate traps, knockout collectors, and tanks. The condensate is then drained back into the landfill.

LFG utilization system

Jaroensompong Corporation has installed a power plant with a capacity of 1MW.

Corrosive elements and contaminants are removed from the LFG using a system composed of condensate tanks and filter tanks.

Jaroensompong Corporation conducted a two-year pilot project to examine the potential of commercial LFG collection/utilization for electricity generation. The pilot project utilized two old engines that had been modified from diesel to gas. The information gathered from the pilot project provided the basis for the final design of the Project.

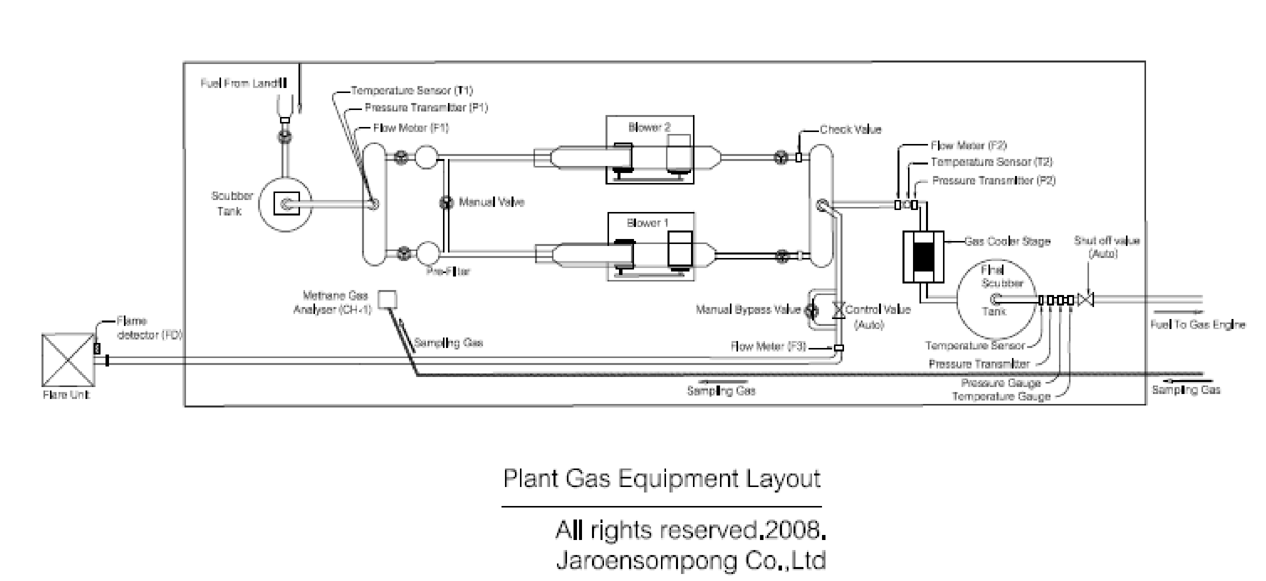
Flaring system

The Project has installed a flaring system to burn excess LFG that is not used in power

generation. An open flare system was selected over an enclosed flare system because it is a less expensive approach for flaring.

The Project employed an advanced foreign technology for electricity generation. As the first landfill site to use this state of the art technology in Thailand, the Project represents an important case for technology transfer.

Figure 1: Process Flow Diagram (PFD)



2. Monitoring methodology and Monitoring plan

2.1. Baseline and monitoring methodology applied

The approved baseline and monitoring methodology applied to the Project Activity is: "Consolidated baseline methodology for landfill gas project activities (ACM0001-version 05)"

The methodology referred to calculate the grid emission factor is: "Grid connected renewable electricity generation (AMS I.D. version 11)"

The tool used for demonstration and assessment of the additionality of the Project Activity is: "Tool for the demonstration and assessment of additionality (version 03)"

The tool used for the determination of project emissions from flaring gases is:

"Methodological Tool to determine project emissions from flaring gases containing methane"

2.2. Calculation method for emission reductions

2.2.1. Emission reductions

In accordance with ACM0001 version 5 that was applied for the Project, the emission reductions achieved by the project activity during a year y were estimated as follows:

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWP_{CH4} + EL_y \times CEF_{electricity,y} - ET_y \times CEF_{thermal,y}$$

where:

ER_y	Emission reductions in tones of CO_2 equivalents (tCO_2e)
$MD_{project,y}$	Amount of methane that would have been destroyed/combusted during the year in tones of methane (tCH_4)
$MD_{reg,y}$	Amount of methane that would have been destroyed/combusted during the year in the absence of the project in tones of methane (tCH_4)
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is 21 tCO_2e/tCH_4
EL_y	Net quantity of electricity exported during year y in megawatt hours (MWh)
$CEF_{electricity,y}$	CO_2 emissions intensity of the electricity displaced in tCO_2e/MWh
ET_y	Incremental quantity of fossil fuel defined as difference of fossil fuel used in the baseline and fossil fuel used during the project for energy requirement on site under project activity during the year in TJ
$CEF_{thermal,y}$	CO_2 emissions intensity of the fuel used to generate thermal/mechanical energy in tCO_2e/TJ

Net quantity of electricity exported during year y in megawatt hours (EL_y) is estimated as follows:

$$EL_y = EL_{EX,LGFG} - EL_{IMP}$$

where:

$EL_{EX,LFG}$	Net quantity of electricity exported during year y produced using landfill gas in megawatt hours (MWh)

EL_{IMP}	Net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements in megawatt hours (MWh)

In cases where the $MD_{reg,y}$ is given/defined as a quantity, that quantity will be used.

In cases where regulatory or contractual requirements do not specify $MD_{reg,y}$ and "Adjustment factor" (AF) shall be used and justified, taking into account the project context.

$$MD_{reg,y} = MD_{projoect,y} \times AF$$

Amount of methane that would have been destroyed/combusted during the year ($MD_{project,y}$) can be arrived at by applying the following equation:

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

where:

$MD_{flared,y}$	Quantity of methane destroyed by flaring during year y (tCH_4/year)
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity during year y (tCH_4/year)
$MD_{thermal,y}$	Quantity of methane destroyed by generation of thermal energy during year y (tCH_4/year)

$$MD_{flared,y} = \left(LFG_{flare,y} \times w_{CH4,y} \times D_{CH4}\right) - \left(PE_{flare,y} \div GWP_{CH4}\right)$$

where:

$LFG_{flare,y}$	Quantity of landfill gas fed to the flare during the year measured in cubic meters (m^3/year)
$w_{CH4,y}$	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (m^3CH_4/m^3LFG)
D_{CH4}	Methane density expressed in tones of methane per cubic meter of methane (tCH_4/m^3CH_4)

$PE_{flare,y}$	Project emissions from flaring during the year y (tCO_2/year)

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} \times (1 - \eta_{flare,h}) \times \frac{GWP_{CH4}}{1000}$$

where:

$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h (kg/h)
$h_{flare,h}$	Flare efficiency in hour h

$$TM_{RG,h} = FV_{RG,h} \times fv_{CH4,RG,h} \times \rho_{CH4,n}$$

where:

$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour h (m^3/h)
$fv_{CH4,RG,h}$	Volumetric fraction of methane in the residual gas on dry basis in hour h
$\rho_{CH4,n}$	Density of methane at normal conditions (0.716 kg/m^3)

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

where:

$LFG_{electricity,y}$	Quantity of landfill gas into electricity generator during the year y (m^3/year)

$$MD_{thermal,y} = LFG_{thermal,y} \times w_{CH4,y} \times D_{CH4}$$

where:

$LFG_{thermal,y}$	Quantity of landfill gas fed into boiler during the year y (m^3/year)

2.2.2. Project emissions

Estimation of project emissions from the flaring system is included in calculation of $MD_{flare,y}$ above.

2.2.3. Leakage

No leakage effects need to be accounted under ACM0001 version 5.

2.3. Monitoring plan and parameters to be monitored

2.3.1. Monitoring Modus Operandi

ID	Data /Parameter	Description	Value	Unit	Source	Note
1	**GWP_{CH4}**	Global warming potential for CH_4	21	tCO_2e/tCH_4	IPCC 2006 Guidelines for National Greenhouse Gas Inventory	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions.
2	**AF**	Adjustment factor	0	N/A	n/a	There are no enforced regulatory or contractual requirements for LFG collection/utilization in Thailand.
3	**EF_{grid}**	CO_2 emission factor of the grid	0.51	tCO_2/ MWh	EGAT, EPPO	Calculated based on the data for the year 2001,2002 and 2003 which are the most recent data available at the time of the validation
4	**EF_{OM}**	CO_2 Operating Margin emission factor of the grid	0.60	tCO_2/ MWh	EGAT, EPPO	None
5	**EF_{BM}**	CO_2 Build Margin emission factor of the grid	0.42	tCO_2/ MWh	EGAT, EPPO	None

2.3.2. *Data and Parameters Monitored: made available by Monitoring Devices (Project's Instrumentations)*

ID	Data/ Parameter	Description	Unit	Monitoring Frequency	Monitoring Device					Data Handling		
					Device ID	Installation	Operation	Maintenance	Calibration	Collection	Processing	Archiving
1	$LFG_{total,y}$	Total amount of landfill gas captured	m^3	minute	FL-02	Referred to 2.3.5.I	Referred to 2.3.6.I	Referred to 2.4.1.I	Referred to 2.4.2.I	Referred to 2.4.3	Referred to 2.4.4	Referred to 2.4.5
2	$LFG_{flare,y}$	Amount of landfill gas flared	m^3	minute	FL-01	Referred to 2.3.5.II	Referred to 2.3.6.II	Referred to 2.4.1.II	Referred to 2.4.2.II			
3	$LFG_{electricity,y}$	Amount of landfill gas combusted in power plant	m^3	minute	FL-03	Referred to 2.3.5.III	Referred to 2.3.6.III	Referred to 2.4.1.III	Referred to 2.4.2..III			
4	$fv_{i,h}$	Volumetric fraction of component i inthe residual gas in the hour h where i = CH4, CO, CO2, O2, H2, N2	-	minute	GA-02	Referred to 2.3.5.IV	Referred to 2.3.6.IV	Referred to 2.4.1.IV	Referred to 2.4.2. IV			
5	$FV_{RG,h}$	Volumetric flow rate of the residual gas in dry basis at normal condition in the hour h	m^3/h	minute	FL-03	Referred to 2.3.5. III	Referred to 2.3.6. III	Referred to 2.4.1III	Referred to 2.4.2. III			
6	Flare operation parameter	Minutes that flare is detected during the hour h (min/h)	min/hr	minute		Referred to 2.3.5.V	Referred to 2.3.6.V	Referred to 2.4.1.V	Referred to 2.4.2.V			
7	$W_{CH4,y}$	Methane fraction in the landfill gas	m3CH4 /m3LFG	minute	GA-02	Referred to 2.3.5. IV	Referred to 2.3.6. IV	Referred to 2.4.1.IV	Referred to 2.4.2. IV			
8	**T**	Temperature of the landfill gas	C	minute	TE-01	Referred to 2.3.5.VII	Referred to 2.3.6.VII	Referred to 2.4.1.VII	Referred to 2.4.2.VII			
9	**P**	Pressure of the landfill gas	Pa	minute	PR-01	Referred to 2.3.5.IX	Referred to 2.3.6.IX	Referred to 2.4.1.IX	Referred to 2.4.2.IX			
10	$EL_{EX,LFG}$	Total amount of electricity exported out of the project boundary	MWh	monthly	This device were installed and has been periodically maintenance and calibrated by MEA							
11	EL_{IMP}	Total amount of electricity imported to meet project requirement	MWh	monthly	This device were installed, and has been periodically maintenance and calibrated by MEA							

12	ET_y	Thermal energy used in landfill during project	TJ	-	-	-	-	-	-			
13	-	Operation of the energy plant	hours	hours	Count by Analog gauge							

2.3.3. Data and Parameters Monitored: made available by Other Sources

ID	Data /Parameter	Description	Unit	Monitoring Frequency	Source
14	-	Regulatory requirements relating to landfill gas projects	-	Yearly	Local/national data

2.3.4. *List, Specification and Appropriateness of All Monitoring Devices*

I.	Device ID	FL-02					
Device Name		Gas Flow Meter		Serial No.	N1U0139599904		
Brand (Manufacturer)		Verabar /SIEMENS		Model	Verabar V100/ 7MF4433-1BA22-146-Z		
Instrument Type		Flow sensor/ Differential pressure transmitter					
Data Measured		Inlet flow (LFG_{total})		CDM ID	Flow meter(F1)		
Measuring Range		from	0	to	1200	unit	M^3/hr
Appropriateness		Yes					

II.	Device ID	FL-01					
Device Name		Gas Flow Meter		Serial No.	N1T1109491336		
Brand (Manufacturer)		Verabar /SIEMENS		Model	Verabar V100/ 7MF4433-1BA22-146-Z		
Instrument Type		Flow sensor/ Differential pressure transmitter					
Data Measured		Flare flow ($LFG_{flare,}$)		CDM ID	Flow meter (F3)		
Measuring Range		from	0	to	1200	unit	M^3/hr
Appropriateness		Yes					

III.	Device ID	FL-03					
Device Name		Gas Flow Meter		Serial No.	N1U0139599905		
Brand (Manufacturer)		Verabar /SIEMENS		Model	Verabar V100/ 7MF4433-1B22-146-Z		
Instrument Type		Flow sensor/ Differential pressure transmitter					
Data Measured		Outlet flow ($LFG_{electricity}$)		CDM ID	Flow meter(F2)		
Measuring Range		from	0	to	800	unit	M^3/hr
Appropriateness		Yes					

IV. Device ID		GA-02					
Device Name		Fixed Type Gas Detector		Serial No.	I-02253		
Brand (Manufacturer)		(HITECH INSTRUMENTS)		Model	HITOX IR-600		
Instrument Type		Gas Detector					
Data Measured		Methane concentration ($W_{CH4,y}$)		CDM ID	Methane Gas Analyzer (CH_4)		
Measuring Range		from	0	to	100	unit	%
Appropriateness		Yes					

V. Device ID		n/a					
Device Name		Flame Detector		Serial No.	945011V		
Brand (Manufacturer)		USHIO INC.		Model	SF-102B		
Instrument Type		Flame Detector					
Data Measured		Flame		CDM ID			
Measuring Range		from	-	to	-	unit	-
Appropriateness		Yes					

VI. Device ID		TE-03					
Device Name		Temperature Controller with PT100		Serial No.	T08151/PT08113		
Brand (Manufacturer)		(SHIMAX with FW System)		Model	Pt100N MAC3D-MCF-NN-NTN with FWP-7A-4.8x30 (S4)		
Instrument Type		Thermocouple and RTD with temperature Controller					
Data Measured		Temperature		CDM ID	Temperature Sensor(T1)		
Measuring Range		from	-50	to	400	unit	C
Appropriateness		Yes					

VII. Device ID		TE-01			
Device Name		Temperature Controller with PT100		Serial No.	T07216/PT07081
Brand		(SHIMAX with FW		Model	Pt100N

	System)			MAC3D-MCF-NN-NTN with FWP-7A-4.8x30 (S4)		
Instrument Type	Thermocouple and RTD with temperature Controller					
Data Measured	Temperature		CDM ID	Temperature Sensor(T2)		
Measuring Range	from	-50	to	400	unit	C
Appropriateness	Yes					

III.	Device ID	PR-03					
Device Name		Pressure Transmitter		Serial No.	07202080001		
Brand (Manufacturer)		(NAGANO)		Model	ADZ-SML-10.0-l		
Instrument Type		Pressure Transmitter					
Data Measured		Pressure (bar)		CDM ID	Pressure Transmitter (P1)		
Measuring Range		from	-1	to	1	unit	bar
Appropriateness		Yes					

IX.	Device ID	PR-01					
Device Name		Pressure Transmitter		Serial No.	1107030328		
Brand (Manufacturer)		(NAGANO)		Model	ADZ-SML-10.0-l		
Instrument Type		Pressure Transmitter					
Data Measured		Pressure (PSI)		CDM ID	Pressure Transmitter (P2)		
Measuring Range		from	-14.7	to	14.7	unit	PSI
Appropriateness		Yes					

X.	Device ID	GA-01					
Device Name		Portable Gas Analyzer		Serial No.	GM07309		
Brand (Manufacturer)		(LANDTEC)		Model	GEM2000		
Instrument Type		Gas Analyzer					
Data Measured		Methane concentration ($W_{CH4,y}$)		CDM ID	*use when GA-02 is out of service		
Measuring Range		from	0	to	100	unit	%
Appropriateness		Yes					

2.3.5. Installation Procedure of All Monitoring Devices

I. Device ID	FL-02	Physical Location	Between Scrubber Tank and Blower
Installation: Refer to Annex 2.3.4 I,II,III-1 Section 7 and Annex 2.3.4 I,II,III-2 Section 5			

II. Device ID	FL-01	Physical Location	Between Blower and Gas Cooler Stage before Gas Engine
Installation: Refer to Annex 2.3.4,II,III-1 Section 7 and Annex 2.3.4.I,II,III-2 Section 5			

III. Device ID	FL-03	Physical Location	Between Blower and Gas Cooler Stage before Gas Engine
Installation: Refer to Annex 2.3.4 I,II,III-1 Section 7 and Annex 2.3.4 I,II,III-2 Section 5			

IV. Device ID	GA-02	Physical Location	Between final condensation tank and gas engine
Installation: Refer to Annex 2.3.4 IV Section 2			

V. Device ID	Flame Detector	Physical Location	Close to flare unit
Installation: The flame detector contains a controller and fiber optic to detect the flame. Fiber optic must be installed inside the flare where the flame can be detected. The gap between the detector and the flame is approximately 30 cm.			

VI. Device ID	TE-03	Physical Location	Close to FL-01
Installation: Refer to Annex 2.3.4 VI,VII-1 and Annex 2.3.4 VI,VII-2			

VII. Device ID	TE-01	Physical Location	Close to FL-03
Installation: Refer to Annex 2.3.4 VI,VII-1 and Annex 2.3.4 VI,VII-2			

VIII. Device ID	PR-03	Physical Location	Close to FL-02 and TE-03
Installation: Refer to Annex 2.3.4. VIII,IX			

IX. Device ID	PR-01	Physical Location	Close to FL-03 and TE-02
Installation: Refer to Annex 2.3.4. VIII,IX			

X. Device ID	Electricity Meter	Physical Location	MEA 24 kv Transmission Line
Installation: The Electricity meter has been installed by MEA			

XI. Device ID	GA-01	Physical Location	-
Installation: - (Portable device)			

2.3.6. Operation/Reading Procedure of All Monitoring Devices

I. Device ID FL-02
Operation/Reading Procedure: Refer to Annex 2.3.4. I,II,III-1 Section 4

II. Device ID FL-03
Operation/Reading Procedure: Refer to Annex 2.3.4. I,II,III-1 Section 4

III. Device ID FL-01
Operation/Reading Procedure: Refer to Annex 2.3.4. I,II,III-1 Section 4

IV. Device ID GA-02
Operation/Reading Procedure: Refer to Annex 2.3.4. IV Section 3

V.Device ID Flame Detector
Operation/Reading Procedure: The detector will detect the flame and then the controller will send the digital signal to data logger automatically.

VI. Device ID TE-03
Operation/Reading Procedure: Refer to Annex 2.3.4. VI,VII-1 and Annex 2.3.4 VI,VII-2

VII. Device ID TE-01
Operation/Reading Procedure: Refer to Annex 2.3.4. VI,VII-1 and Annex 2.3.4 VI,VII-2

VIII. Device ID PR-03
Operation/Reading Procedure: Refer to Annex 2.3.4. VIII,IX

IX. Device ID PR-01
Operation/Reading Procedure: Refer to Annex 2.3.4. VIII,IX

X.Device ID Electricity Meter
Operation/Reading Procedure: Automatically Operate

XI. Device ID GA-01
Operation/Reading Procedure: Annex 2.3.4. XI Section 6

2.4. Quality Assurance (QA) and Quality Control (QC)

2.4.1. Maintenance Procedure of All Monitoring Devices

I. Device ID FL-02
Maintenance Procedure: Annex 2.3.4. I,II,III-1 Section 10 and Annex 2.3.4. I,II,III-2 page 4

II. Device ID FL-03
Maintenance Procedure: Annex 2.3.4. I,II,III-1 Section 10 and Annex 2.3.4. I,II,III-2 page 4

III. Device ID FL-01
Maintenance Procedure: Annex 2.3.4. I,II,III-1 Section 10 and Annex 2.3.4. I,II,III-2 page 4

IV. Device ID GA-02
Maintenance Procedure: Refer to Annex 2.3.4. IV Section 4

V. Device ID Flame Detector

Maintenance Procedure: Maintenance Free. Only replacement.

VI. Device ID TE-03
Maintenance Procedure: Maintenance Free. Only replacement.

VII. Device ID TE-01
Maintenance Procedure: Maintenance Free. Only replacement.

VIII. Device ID PR-03
Maintenance Procedure: Maintenance Free. Only replacement.

IX. Device ID PR-01
Maintenance Procedure: Maintenance Free. Only replacement.

X. Device ID Electricity Meter
Maintenance Procedure: Electricity Meter has been periodically maintained by MEA

XI. Device ID GA-01
Maintenance Procedure: Annex 2.3.4. XI Section 6

2.4.2. Calibration Procedure of All Monitoring Devices

I.Device ID FL-02
Calibration Procedure: Annex 2.3.4. I,II,III-1 Section 10
Calibration Certificate: Annex 2.4.2. I

II. Device ID FL-03
Calibration Procedure: Annex 2.3.4. I,II,III-1 Section 10
Calibration Certificate: Annex 2.4.2. II

III. Device ID FL-01
Calibration Procedure: Annex 2.3.4. I,II,III-1 Section 10
Calibration Certificate: Annex 2.4.2. III

IV. Device ID GA-02
Calibration Procedure: Refer to Annex 2.3.4. IV Section 5
Calibration Certificate: Annex 2.4.2. IV

V.Device ID Flame Detector
Calibration Procedure: Not required as it is only use for detect ON/OFF signal
Calibration Certificate: Not required as it is only use for detect ON/OFF signal

VI. Device ID TE-03
Calibration Procedure: The device has been periodically calibrated respect to each calibration method
Calibration Certificate: Annex 2.4.2. VI

VII. Device ID TE-01
Calibration Procedure: The device has been periodically calibrated respect to each calibration method
Calibration Certificate: Annex 2.4.2. VII

VIII. Device ID PR-03
Calibration Procedure: The device has been periodically calibrated respect to each calibration method
Calibration Certificate: Annex 2.4.2. VIII

IX. Device ID PR-01
Calibration Procedure: The device has been periodically calibrated respect to each calibration method
Calibration Certificate: Annex 2.4.2. IX

X. Device ID Electricity Meter
Calibration Procedure: Electricity Meter has been calibrated properly before operation and periodically calibrated by MEA
Calibration Certificate: As per calibration of MEA

XI. Device ID GA-01
Calibration Procedure: Refer to Annex 2.3.4. XI Section 7

Calibration Certificate: Refer to Annex 2.4.2. XI

2.4.3. Data Collecting Protocol

ID	Data &	Raw data	Collecting Protocol
1	GWP_{CH} :	-	IPCC
2	AF :	-	No enforced regulatory or contractual requirements for LFG
3	EF_{grid} :	-	Announced by DEDE (http://www2.dede.go.th/dede/cdm/511229_2550.pdf)
4	EF_{OM} :	-	
5	EF_{BM}	-	
6	$LFG_{total,y}$	$LFG_{FR,min,i}$	Value measured is sent to the monitoring station
7	$LFG_{flare,y}$	$LFG_{flare,min\ i}$	Value measured is sent to the monitoring station
8	$LFG_{electricity,y}$	$LFG_{electricity,min\ i}$	Value measured is sent to the monitoring station
9	$fv_{i,h}$:	$fv_{CH4,\ min,i}$	Value measured is sent to the monitoring station
10	$FV_{RG,h}$:	$FV_{RG,min\ i}$	Value measured is sent to the monitoring station
11	Flare operation parameter		Value measured is sent to the monitoring station
12	$W_{CH4,y}$:	$W_{CH4,min\ i}$	Value measured is sent to the monitoring station
13	T :	$T_{min\ i}$	Value measured is sent to the monitoring station
14	P:	$P_{min\ i}$	Value measured is sent to the monitoring station
15	$EL_{EX,LFG}$	$EL_{EX,LFG,meter,\ month\ i}$ $EL_{EX,LFG,receipt,\ month\ i}$	Value measured is sent to the monitoring station
16	EL_{IMP} :	$EL_{IMP,meter,month\ i}$ $EL_{IMP,receipt,\ month\ i}$	Value measured is sent to the monitoring station
17	ET_y	$ET_{project}$	No thermal use in plant
18	Operation of the energy plant	Operation of the energy plant	Using analog meter the value recorded by Jaroensompong operator

19	Regulatory requirements relating to landfill gas projects	-	-

2.4.4. *Data Processing Protocol*

2.4.4.1. Raw Data Processing

Collected raw data from monitoring devices have been processed as per Section Raw Data Processing of Annex 2.4.4

Other operational data ($EL_{EX,LFG}$, EL_{IMP}, ET_y, operation of the energy plant) have been processed as per Section Raw Data Processing of Annex 2.4.4

2.4.4.2. Monitored Data Processing

Monitored data have been processed as per the calculation method provided in the registered PDD.

2.4.5. *Data Archiving Protocol*

Collected raw data from monitoring devices have been archived periodically by JS Staff.

Other operational data ($EL_{EX,LFG}$, EL_{IMP}, ET_y, operation of the energy plant) have been archived on monthly basis by JS Staff apart from data from monitoring station.

2.5. Monitoring Team

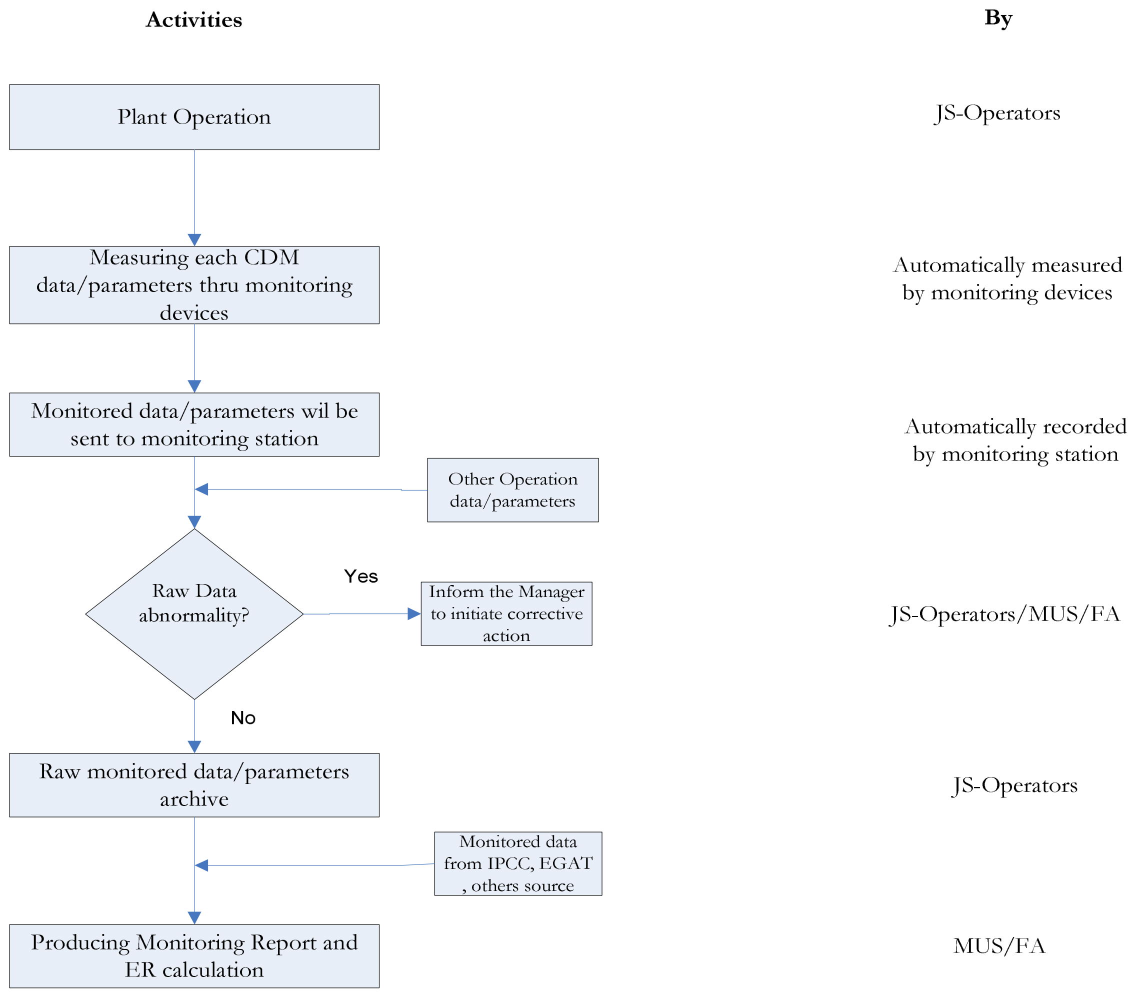
2.5.1. Monitoring Team

ID	Name	Position	Function
1	JS Delegate (s)	Operation Manager	Control overall operation of the plant and CDM activities.
2	JS Staff	Operator	Compiling/Archiving monitored data
3	MUS	Carbon Partner and Advisor	Provide advisory services to JS regarding the CDM transactions and procedures
4	FA Delegate (s)	Consultant	Assist JS in carrying out monitoring activities

- MUS [i.e. Mitsubishi UFJ Securities Co.,Ltd.] is the Carbon Partner/Advisor to JS

- FA [i.e. Full Advantage Co., Ltd.   is the CDM Monitoring Consultant hired by MUS in order to assist JS in appropriately conducting its Monitoring Activities

2.5.2. Monitoring Work Flow



3. Monitoring Result

Detail computation as per Annex 3.4; Computation summary as follow

3.1. Emission reductions

ERC-Emission Reduction Calculation								
ER =	($MD_{project}$ −	MD_{reg}) x	GWP_{CH4} +	EL x	$CEF_{electricity}$	ET x	$CEF_{thermal,m}$	
32,231.271	1,399.891	0.000	21.000	5,556.000	0.5100	0.000	0.000	
unit : tCO_2e	*tCH_4*	*tCH_4*	*$tCO_2e/tCH4$*	*MWh*	*tCO_2e*	*TJ*	*tCO_2e/TJ*	

MD_{reg} =	$MD_{project}$ x	AF
0.000	1,399.891	0.000
unit : tCH_4	*tCH_4*	

$MD_{project,y}$ =	$MD_{flare,}$ +	$MD_{electricity}$ +	$MD_{thermal}$
1,399.891	0.000	1,399.891	0.000
unit : tCH_4	*tCH_4*	*tCH_4*	*tCH_4*

ELy =	$EL_{EX,LGFG}$ -	EL_{IMP}
5,556.000	5,564.000	8.000
unit : MWh	*MWh*	*MWh*

MD flare =	(LFG_{flare} *	$w_{CH4,y}$ *	D_{CH4}) -	(PE_{flare} /	GWP_{CH4})
0.000	101,055.691	0.501	0.001	876.620	21.000
unit : tCH_4	*m^3*	*$m3CH_4/m3LFG$*	*tCH_4/m^3CH_4*	*tCO_2e*	*$tCO_2e/tCH4$*

$MD_{electricity}$	$LFG_{electricity}$	$w_{CH4,y}$ *	D_{CH4}
1,399.891	3,388,933.717	0.501	0.001
unit : tCH_4	*m^3*	*km*	*tCH_4/m^3CH_4*

$MD_{thermal}$ =	$LFG_{thermal}$ *	w_{CH4} *	D_{CH4}
0.000	0.000	0.487	0.001
unit : tCH_4	*m^3*	*m^3CH_4/m^3LFG*	*tCH_4/m^3CH_4*

PE_{flare}	$\sum_{h=1}^{8760} TM_{RG,h}$ *	$(1-\eta_{flare,h})$ *	GWP_{CH4} /	1000
876.620	41,743.794	1.000	0.021	
unit : tCO_2	*kg*			

$TM_{RG,h}$	$FV_{RG,h}$ *	$fv_{CH4,RG,h}$ *	$\rho_{CH4,n}$
7.715	18.678	0.501	0.825
unit : kg/h	*m^3/h*	*m^3CH_4/m^3LFG*	*kg/m^3*

3.2. Project emissions

Calculated per $MD_{flare,y}$.

3.3. Leakage

No leakage effects need to be accounted under ACM0001 version 5.

4. Annexure

- ***Annex 2.3.4-A***[A]: UM – User Manual of fixed/portable measuring devices which are used for Plant Performance Monitoring
  - ***Annex 2.3.4 I,II,III-1 :****Sitrans P Transmitter*
  - ***Annex 2.3.4. I,II,III-2 :****Verabar Flow Censor*
  - ***Annex 2.3.4. IV :****Fixed Type Gas Analyser (IR600)*
  - ***Annex 2.3.4. VI,VII-1 :*** *Temperature Probe (RTD PT100)*
  - ***Annex 2.3.4. VI,VII-2 :****Temperature Controller (Shimax)*
  - ***Annex 2.3.4. VIII,IX :****Pressure Transmitter (NAGANO)*
  - ***Annex 2.3.4. XI :*** *Portable Gas Analyser (GEM2000)*
- ***Annex 2.4.2.-A***[A]: CoC – Certification of Calibration of ALL fixed/portable measuring devices which are used for Plant Performance Monitoring
  - ***Annex 2.4.2. I :****Gas Flow Meter (FL-02)*
  - ***Annex 2.4.2. II :****Gas Flow Meter (FL-01)*
  - ***Annex 2.4.2. III :****Gas Flow Meter (FL-03)*
  - ***Annex 2.4.2. IV :****Fixed Type Gas Analyser (GA-02)*
  - ***Annex 2.4.2. VI :****Temperature Controller with PT100 (TE-03)*
  - ***Annex 2.4.2. VII :****Temperature Controller with PT100 (TE-01)*
  - ***Annex 2.4.2. VIII :****Pressure Transmitter (PR-03)*
  - ***Annex 2.4.2. IX :****Pressure Transmitter (PR-01)*
  - ***Annex 2.4.2. XI :*** *Portable Gas Analyser (GA-01)*

- ***Annex 2.4.4*** : ERCF - Emission Reduction Computation Frame Work
- ***Annex 3.4*** : ERC – Emission Reduction Calculation

Note:

A. Only the content related to the annual Verification will be seen by the DOE
B. Only ONE exemplar will be seen by the DOE