



## Monitoring report form (Version 03.1)

### Monitoring report

<b>Title of the project activity</b>	Jinju Landfill Gas Recovery and Power Generation CDM Project
<b>Reference number of the project activity</b>	6922
<b>Version number of the monitoring report</b>	Version 1
<b>Completion date of the monitoring report</b>	12/08/2013
<b>Registration date of the project activity</b>	16/08/2012
<b>Monitoring period number and duration of this monitoring period</b>	1 <sup>st</sup> monitoring period (01/09/2012 – 31/08/2013)
<b>Project participant(s)</b>	- Nurieconet Co., Ltd - Jinju City
<b>Host Party(ies)</b>	Republic of Korea
<b>Sectoral scope(s) and applied methodology(ies)</b>	Sectoral scopes: - 01-Energy industry (renewable and non-renewable sources) - 13-Waste handling and disposal Applied Methodologies: - AMS I. D: Grid connected renewable electricity generation_V.17 - AMS III. G: Landfill methane recovery_V.7
<b>Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD</b>	38,376 tCO <sub>2</sub> -eq
<b>Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period</b>	23,431 tCO <sub>2</sub> -eq

**SECTION A. Description of project activity****A.1. Purpose and general description of project activity**

“Jinju Landfill Gas Recovery and Power Generation CDM Project” is for landfill gas collection and utilization as a renewable energy project, developed by Nurieconet Co., Ltd. in collaboration with Jinju City.

The Jinju Landfill began operation in January 1995 with a total volume of 5,855,000m<sup>3</sup> dumping zone, designed to treat the municipal solid waste (MSW) and prior to this proposed project, Jinju Landfill has emitted landfill gas (LFG) into the atmosphere directly without recovery and/or utilization.

**Purpose of the Project Activity**

The purpose of the project activity is to reduce greenhouse gas emissions (GHGs) by collecting LFG from landfill and generating electricity for replacing fossil fuel with renewable energy. The generated electricity is transmitted to the grid of Korea Electric Power Corporation.

**Installed Technology and Equipment**

The proposed project activity involves the installation of a landfill gas collecting system, a gas pre-treatment system, an electricity generation system with capacity of 925 kW and a monitoring system (LFG flow meters, a methane analyzer and electricity meters).

**Total GHG emission reductions achieved in this monitoring period**

The Certified Emission Reductions (CERs) volume claimed for the monitoring period extending from September 1, 2012 to August 31, 2013 is 23,431 tCO<sub>2</sub>e.

**Relevant dates for the project activity;**

Date	Project Schedule
May 2010	Draft Engineering work report on “Jinju Landfill Gas Recovery and Power Generation CDM Project”
April 2011	Final Engineering work report on “Jinju Landfill Gas Recovery and Power Generation CDM Project”
10 <sup>th</sup> June 2011	Conclusion of a contract among Jinju City Hall, Korea Environment Corporation and Nurieconet Co., Ltd
14 <sup>th</sup> October 2011	Starting date of construction (civil engineering work)
26 <sup>th</sup> October 2011	Approval of construction business
5 <sup>th</sup> December 2011	Approval of electricity generation business
8 <sup>th</sup> March 2012	The installation of 925 kW generator
9 <sup>th</sup> March 2012	End of Self-testing date for 10days
9 <sup>th</sup> April 2012(expected date)	End of trial operation date for one month from 9 <sup>th</sup> March

### A.2. Location of project activity

The proposed project is located in San 287, Yusu-Ri, Naedong-Myeon, Jinju-Si, Gyeongsangnam-Do, Republic of Korea, which is the province located in south-east part of Korea; latitude North 35.119074° and longitude East 128.014091° and Jinju landfill is located around mountain area at where is 1 ~ 1.3km away from the local village.

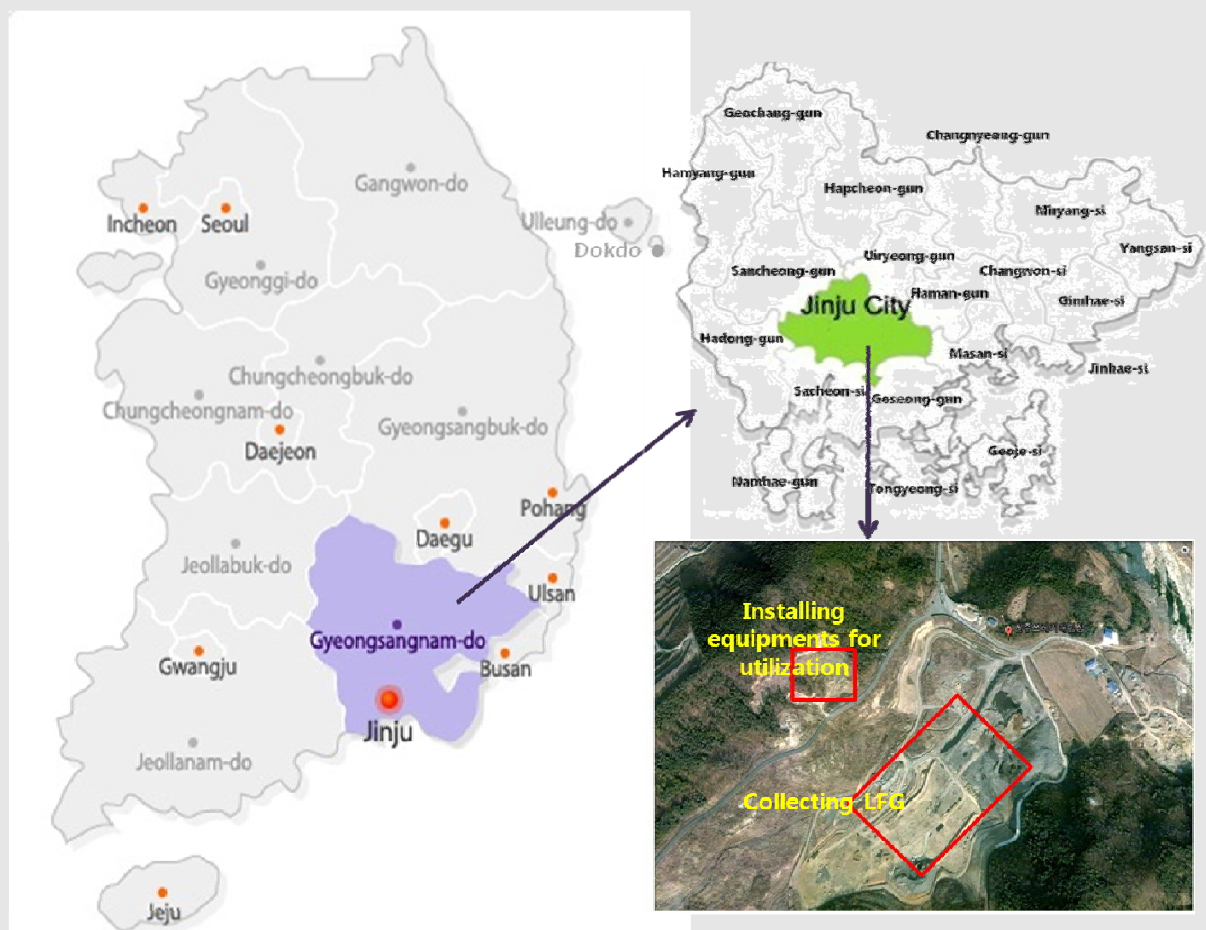


Figure A-1 Geographic location of the proposed project

### A.3. Parties and project participant(s)

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant(Yes/No)
Republic of Korea(host)	Nurieconet Co., Ltd	No

### A.4. Reference of applied methodology

#### The approved small-scale CDM baseline methodologies:

- AMS I. D: Grid connected renewable electricity generation\_V.17
- AMS III. G: Landfill methane recovery\_V.7

**The tools referred by the approved methodology:**

- Emissions from solid waste disposal sites \_V.6.0.1
- Tool to calculate the emission factor for an electricity system \_V.2.2.1
- Tool for the demonstration and assessment of additionality \_V.6.0.0

**A.5. Crediting period of project activity**

The crediting period for this project activity is from August 16, 2012 to August 31, 2022. This is the 1st consecutive monitoring period corresponding to September 1, 2012 to August 31, 2013.

The start date of this project is 16/08/2012 and crediting period chosen is 10years (fixed)

Registration date: 16/08/2012

Length of crediting period: 10years

Crediting period: 01/09/2012 ~ 31/08/2022

**SECTION B. Implementation of project activity****B.1. Description of implemented registered project activity**

A 925 kW power generator has been installed in 2012 and been operated by Nurieconet since 09/03/2012. Other facilities such as LFG blower has been installed and operated before start date of crediting period. The CDM project monitoring activity has been started since 01/09/2012.



**Figure B-1 The view of Jinju LFC power plant**

*The description of the technology in the proposed project is provided below*

The main components of the proposed project are a landfill gas collecting system, a pre-treatment system, an electricity generation system and a monitoring system. This Project activity involves the best available installation of:

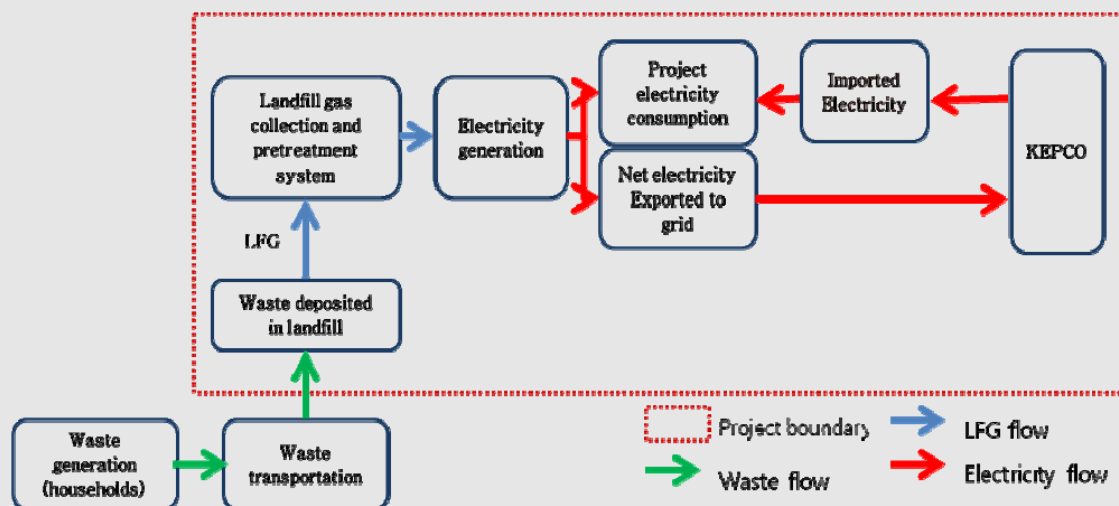


Figure B-2 The proposed project boundary

### **Landfill gas collecting system**

The landfill gas extraction system is a gas transportation network, consisting of vertical and horizontal gas wells, well head station, J-Trap and B-Trap, a main pipeline to extract and convey the landfill gas from the landfill to the gas pre-treatment system. For operation efficiency increase and continuous power production, collecting landfill gas will be controlled by gas valves to be continuously collected from the gas wells.

### **Gas pre-treatment system**

Prior to electricity generation, the landfill gas must be pre-treated to remove its impurities and moisture to prevent corrosion which could cause generator shutdown. The pre-treatment consists of 1) CSV (Condensate Separation Vessel), 2) separator, 3) heat exchange and chiller, 4) H<sub>2</sub>S remover, 5) gas filter, 6) receiver tank, and 7) gas boosting air blower.

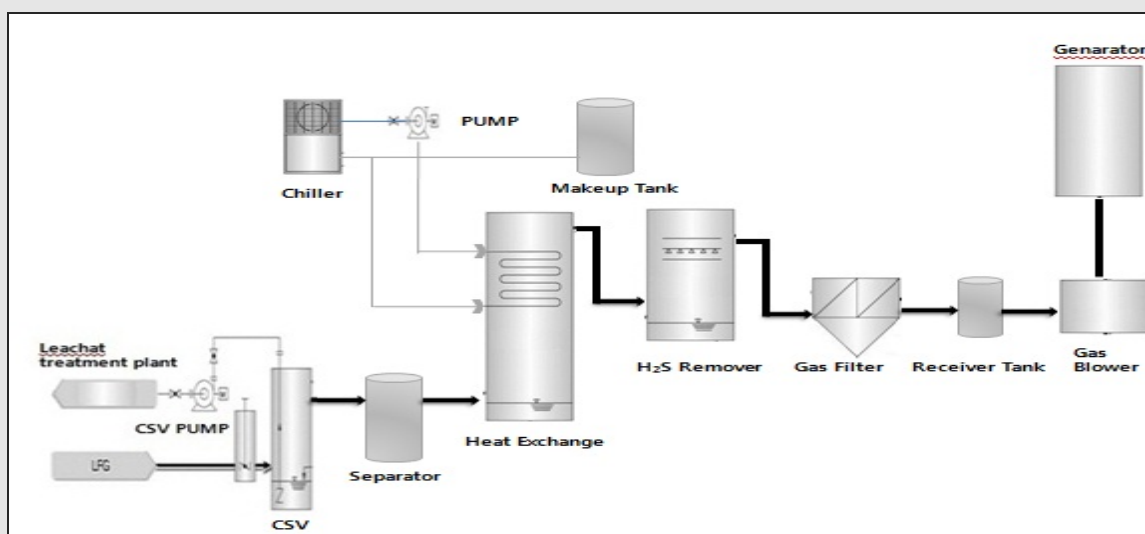


Figure B-3 The LFG pre-treatment process

H<sub>2</sub>S is one of toxic components of landfill gas. If H<sub>2</sub>S is not refined, it could create negative effects

on the generator, and when it is supplied directly to the generator and emits air pollutants such as sulfur oxide with exhaust fumes during operation. So H<sub>2</sub>S remover is installed.

### **Power generation technology**

The proposed project is designed to install one generator with capacity of 925 kW in the Jinju landfill. The collected landfill gas will be sent to the generators and the electricity generated is exported to the grid-connected system of the Korea Electric Power Corporation (KEPCO) supply system. The technical specification of the power generation system is shown in the table.

**Table B-1 The technical data of engine and power generator**

LANDFILL GAS ENGINE GENERATOR (925 kW*1 SET)	Gas engine technical specification	Manufacturer	CATERPILLAR INC. (U.S.A)
		Model	G3516 LE SITA
		Engine power	974 kW
		Fuel consumption	546 Nm <sup>3</sup> /h (100% load)
	Generator technical specification	Manufacturer	CATERPILLAR INC. (U.S.A)
		Type	BRUSHLESS, REVOLVING FIELD EXCITATION
		Generator power	925 kW
		Frequency	60 Hz
		Voltage	480 V
		Speed	1200 rpm

Gas There was no significant event affecting on the amount of reduction during the monitoring period. And also, any regulation or policy has not changed that could affect the normal operation of the project or the applicability of the methodology.

There was no monitoring equipment malfunction and the monitoring was carried out in accordance with the registered PDD. The monitoring is compliant with the monitoring plan as described in "Jinju Landfill Gas Recovery and Power Generation CDM Project".

During monitoring period, critical events in regard to actual operation data are below and all of them should not be involved in emission reductions ;

Date	Duration (hour)	Operation events
08/09/2012	04:00-12:00 (9)	Automatically shut off electricity transmission to KEPCO by lightning and strong wind (ACB shut off by discordance of frequency and voltage)
17/09/2012- 25/09/2012	12:00- 15:00 (196)	Breakdown in cooling water pump(leak of cooling water)
30/09/2012	08:00 (1)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
12/10/2012- 16/10/201	01:00-16:00 (112)	Breakdown in Generator igniter system(TR,tm 파크플러그 외)
21/10/2012	08:00-10:00 (3)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
23/10/2012	08:00-09:00 (2)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay

24-10-2012	14:00-15:00 (2)	Replacement and maintenance of condenser's components
01/11/2012	06:00-08:00 (3)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
01/11/2012-06/11/2012	12:00-10:00 (118)	Generator's oil cooler malfunction
07/11/2012	07:00-15:00 (9)	Filling up cooling water and antifreeze in the generator
10/11/2012	02:00-10:00 (9)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
11/11/2012	07:00-11:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
12/11/2012	08:00-10:00 (3)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
13/11/2012	08:00-10:00 (3)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
14/11/2012	08:00-09:00 (2)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
16/11/2012	09:00-10:00 (2)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
17/12/2012	08:00-09:00 (2)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
18/11/2012	07:00-13:00 (7)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
19/11/2012	05:00-09:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
20/11/2012	05:00-09:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
21/11/2012	05:00-09:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
22/11/2012	04:00-08:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
23/11/2012	05:00-0800 (4)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
24/11/2012	04:00-08:00 (5)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
25/11/2012	06:00-11:00 (6)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
26/11/2012	04:00-09:00 (6)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
27/11/2012	05:00-08:00 (4)	Emergency shutdown; Automatically run of VCB(Vacuum Circuit Breaker) caused by OCGR(over current ground relay
18/12/2012-20/12/2012	08:00-15:00 (56)	The regular maintenance of generator
21/12/2012	10:00-15:00 (6)	Shut off electricity exported and imported caused by hit electrical pole by car
27/12/2012	13:00-14:000 (2)	Discordance of frequency and voltage, caused by heavy snow
28/12/2012	10:00-17:00 (8)	Discordance of frequency and voltage, caused by heavy snow

03/01/2013	11:00-12:00 (2)	Exchange of engine oil
08/03/2013- 09/03/2013	20:00-19:00 (24)	Desulfurizing agent exchange
16/03/2013- 18/03/2013	13:00-18:00 (54)	Shut off by unusual breakdown of generator
14/04/2013- 20/04/2013	12:00-18:00 (151)	Gas collecting facilities installation
12/05/2013	12:00-16:00 (5)	Exchange engine oil
20/05/2013	06:00-09:00 (4)	Breakdown in Generator igniter system
25/05/2013	15:00 (1)	New gas collecting facilities installation (wellhead J,K)
29/05/2013	15:00-16:00 (2)	New gas collecting facility wellhead J repair
05/06/2013	11:00-15:00 (5)	Construction of electrical pole
07/06/2013- 10/06/2013	10:00-18:00 (81)	New gas collecting facility wellhead J repair
15/06/2013	10:00-22:00 (13)	The regular maintenance of generator (1,000 hours)
18/06/2013- 19/06/2013	19:00-10:00 (16)	Shut off by unusual power frequency flow
17/07/2013	14:00-19:00 (6)	Exchange engine oil and cooling water
24/07/2013	12:00-19:00 (8)	Exchange cooling water
27/07/2013	18:00 (1)	Temporary shut down by 발전기 리버스 파워
04/08/2013	18:00 (1)	Temporary shut down by 발전기 리버스 파워
09/08/2013- 13/08/2013	24:00-1:00 (74)	The regular maintenance of generator (1,000 hours) and exchange of desulfurizer
22/08/2013	07:00-09:00 (3)	Temporary shut down by 발전기 리버스 파워
24/08/2013	15:00-18:00 (4)	Temporary shut down by 발전기 리버스 파워
31/08/2013	20:00-21:00 (2)	Temporary shut down by 발전기 리버스 파워

## B.2. Post registration changes

### B.2.1. Temporary deviations from registered monitoring plan or applied methodology

There are no temporary deviations from the registered monitoring plan or the applied methodology.

### B.2.2. Corrections

There are no corrections to project information or parameters fixed at validation that have been approved during this monitoring period or submitted with this monitoring report.



**B.2.3. Permanent changes from registered monitoring plan or applied methodology**

Not applicable.

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

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

**B.2.5. Changes to start date of crediting period**

There are no changes to the start date of the crediting period

01/09/2012, or the date of registration; Starting date of crediting period will be on the date of registration as a CDM project

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

Not applicable

**SECTION C. Description of monitoring system**

Calculation of emission reductions by monitoring data is made in accordance with monitoring plan in PDD, internal data handling procedure as well as approved methodologies.

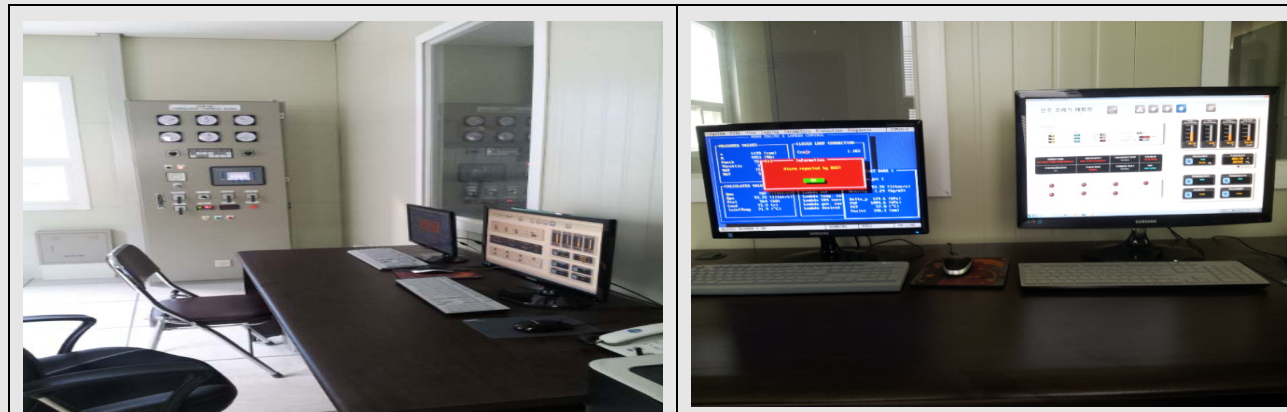


Figure C-1 Monitoring control system

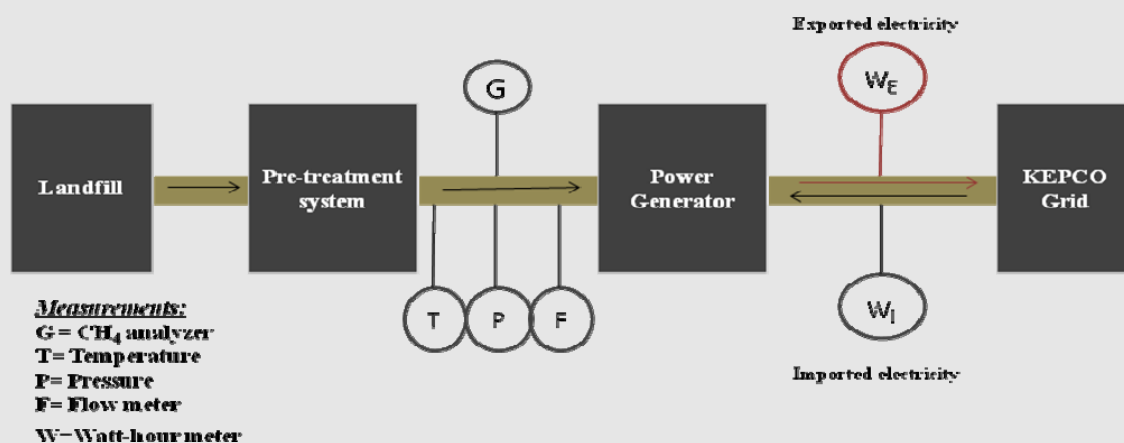


Figure C-2 The Location of the Monitoring facilities and points

**Monitoring system**

The monitoring instruments to be installed in the project activity include LFG flow meters, a methane analyzer and electricity meters. All the monitoring instruments meet the relevant accuracy requirements.

**Information of monitoring facilities**

Facility		Brand	Install date	Maintenance date	
Gas flow meter		CS Instruments	2012.03.08	2015.03.07	Once /3 years
Gas analyzer		Geotechnical Instruments(UK) Ltd	2012.03.07	2015.03.06	Once/3years
Power transmission system	Export	남전사 co., ltd.	2012.03.28	-	Exemption
	Import	남전사 co., ltd.	2012.03.14	2014.03.13	Exemption

**The description of the technology installed in jinju landfill project site:**

- A Gas flow meter is installed between blower and generating facility to measure LFG flow rate; temperature and pressure are automatically measured.

Gas flow meter		
Model	CS Instruments	VA 450 thermal mass flow meter
Spec	Measuring range	0.4 ~ 92.7 sm/s (standard range calibration) 0.8 ~ 185 sm/s (max range calibration)
	Accuracy	±1.5% of reading + 0.3% full scale
	Measuring medium	Any gas where the components and the mixing ration are constant and known.
	Operating temperature	-40 ~ +150 °C (medium temperature) -40 ~ +65 °C (ambient temperature)
	Operating pressure	1.6 Mpa ( 16 bar )
Calibration	Calibrate the meter every three year	

- A methane analyzer is located before the above flow meter to measure the fraction of methane in LFG volume fed into the gas engine.

Methane analyzer		
Model	Geotechnical Instruments (UK) Ltd	GA3000 Range Gas Analyser
Spec	Calibration gas	CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub>
	Measuring range	CH <sub>4</sub> : 0-70% specification, 0-100% reading CO <sub>2</sub> : 0-60% specification, 0-100% reading O <sub>2</sub> : 0-25%
	Accuracy	CH <sub>4</sub> : 0~5%: $\pm 0.5\%$ (vol), 5~15%: $\pm 1.0\%$ (vol), 15%-FS: $\pm 3.0\%$ (vol) CO <sub>2</sub> : 0~5%: $\pm 0.5\%$ (vol), 5~15%: $\pm 1.0\%$ (vol), 15%-FS: $\pm 3.0\%$ (vol) O <sub>2</sub> : 0~5%: $\pm 1.0\%$ (vol), 5~15%: $\pm 1.0\%$ (vol), 15%-FS: $\pm 1.0\%$ (vol)
	Measuring medium	Continuous for CH <sub>4</sub> , CO <sub>2</sub> , O <sub>2</sub>
	Operating temperature	-5 ~ 40°C
Calibration	Calibrate the meter every three year	

- Electricity measuring meter is to be set-up transparently in accordance with “Measures Act” and “Act on operation of electricity market”. Thereafter, the meter is calibrated when installed behind the generator and sealed up under the authority of KEPCO after affirmation of Korea Power Exchange. Exported electricity will be measured by watt-hour meter and the amount of exported electricity will be monitored continuously. Imported electricity will be measured by watt-hour meter and monitored continuously. The amount of imported electricity will be not same amount as it depends on how much electricity will be used for proposed project.



The gas flow meter



The gas analyzer



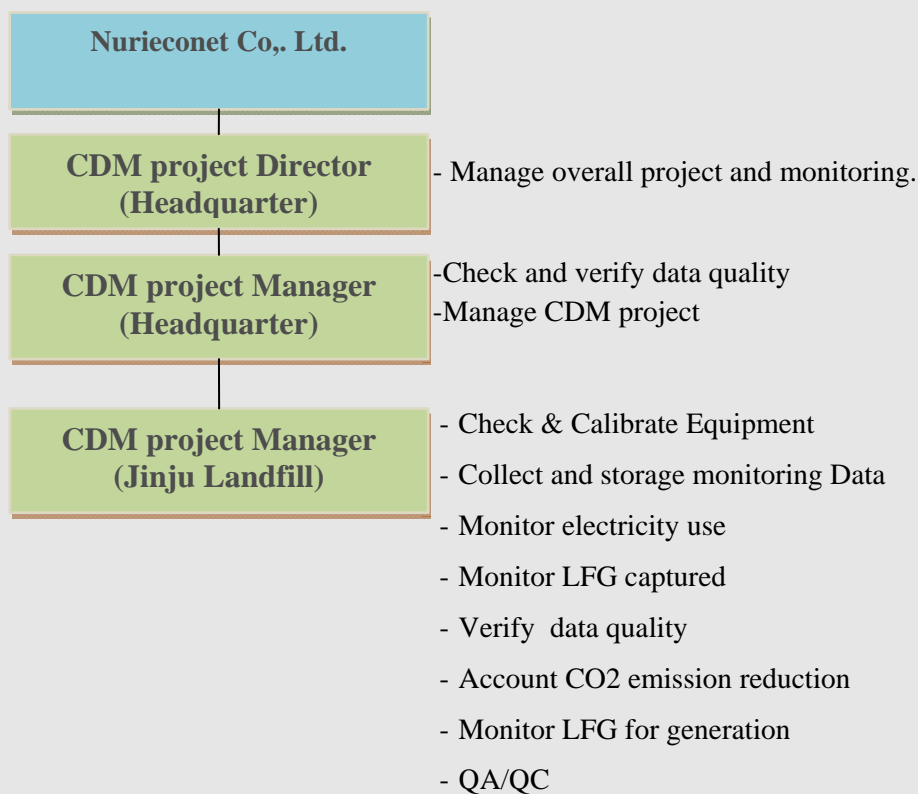
The watt-hour meter for exported electricity



The watt-hour meter for imported electricity

### **Monitoring organization:**

The following figure describes the operation and management structure for monitoring and shows the responsible party.



**Figure C-3 The structure of monitoring organization**

**Table C1 The responsible party for each task of monitoring.**

Item	Sub-item	Responsible person
Measure & Archive	LFG electricity, y	Responsible company and/or team for the project : Jinju Operating Team, Nurieconet
	wCH4,y	
	ELEXP, PJT, y	
	ELIMP, PJT, y	
Measuring instrument check & Calibration	Centralized monitoring system	Responsible company and/or team for the project : Jinju Operating Team, Nurieconet
	Flow meter	
	Gas analyzer	
	Watt-hour meter	Responsible company and/or team for the project: Korea Power Exchange (According to “Measures Act” and : act on operation of electricity market”)
Establish monitoring plan		Responsible company and/or team for the project : Jinju Operating Team, Nurieconet Monitoring consulting team, CARBONTREE
Task coordination		
Monitoring report		

**Quality control (QC) and quality assurance (QA) procedures:**

Jinju Operating Team is the responsible team for quality management, which ensures the quality and accuracy of the measured data. For quality management, the following items are included: data records and data storage, equipment calibration and maintenance, corrective action, and Emergency procedures for unintended emissions.

- A gas flow meter will be installed between blower and generating facility; automatically calibrated meter of temperature and pressure, and operated in accordance with AMS III.G. When it has a problem to measure LFG flow rate, the IPCC default factor will be used for methane content in the LFG.

- A methane analyzer is located before the above flow meter to measure the fraction of methane in LFG volume fed into the gas engine.

- Electricity will be set-up transparently in accordance with “Measures Act” and “Act on operation of electricity market”. Thereafter, the meter is calibrated when installed behind the generator and sealed up after affirmation of Korea Power Exchange.

- The amount of electricity exported (WE) to the grid-connected system is measured by watt-hour meter. The measured data is simultaneously transferred to Korea Power Exchange and the amount of imported electricity (WI) is measured by a meter, as well. The measured data is also checked by central control system of Korea Power Exchange and they are collected daily, weekly and monthly in electronic way. If the landfill site data differs from that of the Korea Power Exchange, each data should be inspected. The collected data should be kept during the crediting period and 2 years after.

If any monitoring equipments are considered to perform abnormally, appropriate actions will be taken immediately.

**Data records and storage:**

All the daily data related to CDM project are documented on paper and archived in electronic files and kept during the crediting period and two years after. The measured data is monitored on a computer and Jinju Operating Team should check them continuously.

**Equipment calibration and maintenance:**

- Jinju Operating Team should check monitoring plan and/or schedules, and also calibrate generators periodically in line with procedure calibration manual from related manufacturer. The equipment, related to CDM project could be calibrated by Jinju Operating Team if necessary.

- The watt-hour meter is subject to a regular maintenance and testing regime to ensure accuracy. As to calibration of electricity imported meter, it will be calibrated by regulation of "Measures Act". The calibration period is every seven years. As to exported electricity, electricity meter will be calibrated in accordance with "General Guidelines to SSC CDM methodologies", and update version of CDM regulation.

Name of equipments	Manufacturer	Date of install	Date of calibration	note
Flow meter	CS Instruments	2012.03.08	2015.03.07	Once/ 3years
Gas analyzer	Geotechnical Instruments(UK) Ltd	2012.03.07	2015.03.06	Once/3years
Watt-hour meter	Exported electricity	NamJun Co.,ltd.	2012.03.28	not applicable
	Imported electricity	NamJun Co.,ltd.	2012.03.14	not applicable

**Corrective action:**

Jinju Operating Team will report all issues and data related to plant operation to Jinju Operating Team. Operation review, internal audit and corrective action are carried out by Jinju Operating Team, according to the , "Operating Manual-Jinju Landfill Gas Recovery and Power Generation CDM Project".

**Emergency procedure:**

In case of emergency situation, proper action is carried out to minimize damage in accordance with "Operating Manual-Jinju Landfill Gas Recovery and Power Generation CDM Project".

**Training:**

All employees involved in this project should be trained in knowledge/information of operating equipment and monitoring by skilled technician from the Generator manufacturer, and/or participate in training programs. The employees should attain a comprehensive knowledge, regard to the general and technical aspects of CDM project.

**SECTION D. Data and parameters****D.1. Data and parameters fixed**

Data / Parameter:	Operation Margin Emission Factor (EFOM)
Unit:	ton CO <sub>2</sub> e/MWh
Description:	The generation-weighted average of CO <sub>2</sub> emission per electricity unit generated by the existing grid-connected power plants
Source of data:	"Statistics of Electric Power in Korea"
Value(s) applied:	0.6933
Purpose of data:	Calculation of Baseline/ Project emission
Additional comment:	This Operating Margin Emission Factor is fixed for the crediting period.

Data / Parameter:	Build Margin Emission Factor (EFBM)
Unit:	ton CO <sub>2</sub> e/MWh
Description:	The generation-weighted average of CO <sub>2</sub> emission per electricity unit generated by additionally constructed power plants.
Source of data:	"Statistics of Electric Power in Korea"
Value(s) applied:	0.6357
Purpose of data:	Calculation of Baseline/ Project emission
Additional comment:	This Operating Margin Emission Factor is fixed for the crediting period.

Data / Parameter:	CO <sub>2</sub> Emission Intensity of the Electricity displaced (CEFelectricity)
Unit:	ton CO <sub>2</sub> e/MWh
Description:	The weighted average of EFOM and EFBM
Source of data:	"Statistics of Electric Power in Korea"
Value(s) applied:	0.6645
Purpose of data:	Calculation of Baseline/ Project emission
Additional comment:	This Operating Margin Emission Factor is fixed for the crediting period.

Data / Parameter:	GWPC <sub>H4</sub>
Unit:	ton CO <sub>2</sub> e/tCH <sub>4</sub>
Description:	Global warming potential for methane (CH <sub>4</sub> )
Source of data:	Default value in IPCC
Value(s) applied:	21
Purpose of data:	Calculation of Baseline/ Project emission
Additional comment:	N/A

Data / Parameter:	DCH <sub>4</sub>
Unit:	ton CH <sub>4</sub> /Nm <sup>3</sup>
Description:	Density of methane
Source of data:	Default value in IPCC
Value(s) applied:	0.0007168
Purpose of data:	Calculation of Baseline/ Project emission
Additional comment:	N/A

**D.2. Data and parameters monitored**

Data / Parameter:	LFG electricity, y	
Unit:	Nm <sup>3</sup> /y	
Description:	Amount of landfill gas combusted in power plant	
Measured/Calculated / Default:	Measured	
Source of data:	Gas flow meter	
Value(s) of monitored parameter:	Date	Measured LFG electricity, y(Nm <sup>3</sup> )
	2012.09.01-2012.09.30	167,904.00
	2012.10.01-2012.10.31	197,999.00
	2012.11.01-2012.11.30	199,905.00
	2012.12.01-2012.12.31	254,756.00
	2013.01.01-2013.01.31	306,568.00
	2013.02.01-2013.02.28	264,956.00
	2013.03.01-2013.03.31	251,578.00
	2013.04.01-2013.04.30	216,240.00
	2013.05.01-2013.05.31	352,113.00
	2013.06.01-2013.06.30	216,693.00
	2013.07.01-2013.07.31	234,099.00
	2013.08.01-2013.08.31	268,172.00
	2012.09.01-2013.08.31	2,930,983.00
	Measured landfill gas flow data is monitored automatically by continuous flow meters. All measured data for the crediting period was submitted to the DOE as a spread sheet.	
Monitoring equipment:	- Model: CS Instruments/ VA 450 thermal mass flow meter - Calibration: Calibrate the meter every three year	
Measuring/Reading/Recording frequency:	Measured automatically.	
Calculation method (if applicable):	Not applied.	
QA/QC procedures:	To ensure accuracy, the flow meters are subject to regular maintenance and testing. The flow meter is calibrated every three years. - Date of installation: 08/03/2012 - Date of Initial test: 07/03/2012 - Date of calibration: 06/03/2015	
Purpose of data:	Calculation of Baseline emission	
Additional comment:	Not applied.	

Data / Parameter:	wCH <sub>4</sub> ,y
Unit:	%
Description:	Methane fraction in LFG
Measured/Calculated / Default:	Measured
Source of data:	Methane analyzer



Value(s) of monitored parameter:	- Weighted average CH4 concentration during the monitoring period	
	Date	Measured CH4(%)
	2012.09.01-2013.08.31	47.70
	The measured methane fraction data is monitored automatically and continuously by gas analyser. All measured data for the crediting period submitted to the DOE as a spread sheet.	
Monitoring equipment:	- Model: Geotechnical Instruments (UK) Ltd/ GA3000 Range Gas Analyser -Calibration: Calibrate the meter every three year	
Measuring/Reading/Recording frequency:	Measured automatically.	
Calculation method (if applicable):	Not applied.	
QA/QC procedures:	To ensure accuracy, the gas analyzer is subject to regular maintenance and testing regime in accordance with the manufacturer's specification. The methane analyzer is calibrated every three years.  - Date of installation: 07/03/2012 - Date of Initial test: 06/13/2012 - Date of calibration: 06/03/2015	
Purpose of data:	Calculation of Baseline emission	
Additional comment:	Not applied.	

Data / Parameter:	ELEXP, PJT, y	
Unit:	MWh	
Description:	Total amount of exported electricity out of the project	
Measured/Calculated/Default:	Measured	
Source of data:	Watt-hour meter	
Value(s) of monitored parameter:	Date	Measured EL <sub>EXP</sub> (MWh)
	2012.09.01-2012.09.30	248.81
	2012.10.01-2012.10.31	297.82
	2012.11.01-2012.11.30	271.21
	2012.12.01-2012.12.31	274.97
	2013.01.01-2013.01.31	321.84
	2013.02.01-2013.02.28	232.91
	2013.03.01-2013.03.31	226.39
	2013.04.01-2013.04.30	234.38
	2013.05.01-2013.05.31	420.87
	2013.06.01-2013.06.30	338.74
	2013.07.01-2013.07.31	396.59
	2013.08.01-2013.08.31	336.33
	2012.09.01-2013.08.31	3,600.87
	The imported electricity data is automatically monitored by a certified meter. All measured data for the crediting period submitted to the DOE as a spread sheet.	
	Monitoring equipment:	-Serial No: -Accuracy level: 1s

Measuring/Reading/ Recording frequency:	Measured automatically.	
Calculation method (if applicable):	Not applied.	
QA/QC procedures:	<p>To ensure accuracy, the watt-hour meter is subject to regular maintenance and testing regime complying with the “Act for measurement” and “Regulation for operation of electricity market” in South Korea.</p> <p>The watt-hour meter is calibrated every two years.</p> <p>- Date of installation: 28/03/2012 - Date of Initial test: N/A - Date of calibration: N/A</p>	
Purpose of data:	Calculation of Project emission	
Additional comment:	Not applied.	

Data / Parameter:	ELIMP, PJT, y																													
Unit:	MWh																													
Description:	Total amount of exported electricity out of the project																													
Measured/Calculated/ Default:	Measured																													
Source of data:	Watt-hour meter																													
Value(s) of monitored parameter:	<table border="1"> <thead> <tr> <th>Date</th> <th>Measured EL<sub>IMP</sub> (MWh)</th> </tr> </thead> <tbody> <tr><td>2012.09.01-2012.09.30</td><td>0.27</td></tr> <tr><td>2012.10.01-2012.10.31</td><td>1.03</td></tr> <tr><td>2012.11.01-2012.11.30</td><td>1.07</td></tr> <tr><td>2012.12.01-2012.12.31</td><td>0.73</td></tr> <tr><td>2013.01.01-2013.01.31</td><td>0.75</td></tr> <tr><td>2013.02.01-2013.02.28</td><td>0.01</td></tr> <tr><td>2013.03.01-2013.03.31</td><td>-</td></tr> <tr><td>2013.04.01-2013.04.30</td><td>0.64</td></tr> <tr><td>2013.05.01-2013.05.31</td><td>1.26</td></tr> <tr><td>2013.06.01-2013.06.30</td><td>0.13</td></tr> <tr><td>2013.07.01-2013.07.31</td><td>0.76</td></tr> <tr><td>2013.08.01-2013.08.31</td><td>0.15</td></tr> <tr><td>2012.09.01-2013.08.31</td><td>6.79</td></tr> </tbody> </table> <p>The imported electricity data is automatically monitored by a certified meter. All measured data for the crediting period submitted to the DOE as a spread sheet.</p>		Date	Measured EL <sub>IMP</sub> (MWh)	2012.09.01-2012.09.30	0.27	2012.10.01-2012.10.31	1.03	2012.11.01-2012.11.30	1.07	2012.12.01-2012.12.31	0.73	2013.01.01-2013.01.31	0.75	2013.02.01-2013.02.28	0.01	2013.03.01-2013.03.31	-	2013.04.01-2013.04.30	0.64	2013.05.01-2013.05.31	1.26	2013.06.01-2013.06.30	0.13	2013.07.01-2013.07.31	0.76	2013.08.01-2013.08.31	0.15	2012.09.01-2013.08.31	6.79
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QA/QC procedures:	<p>To ensure accuracy, the watt-hour meter is subject to regular maintenance and testing regime complying with the “Act for measurement” and “Regulation for operation of electricity market” in South Korea.</p> <p>The watt-hour meter is calibrated every two years.</p> <ul style="list-style-type: none"> <li>- Date of installation: 28/03/2012</li> <li>- Date of calibration: N/A</li> <li>- Date of Initial test: 13/03/2012</li> </ul>
Purpose of data:	Calculation of Project emission
Additional comment:	Not applied.

**D.3. Implementation of sampling plan**

N/A

**SECTION E. Calculation of emission reductions or GHG removals by sinks****E.1. Calculation of baseline emissions or baseline net GHG removals by sinks**

$$ER_y = (MD_y - MD_{reg,y}) + (E_{LEXP, PJT, y} - E_{LIMP, PJT, y}) * EF - \text{Leakage}$$

Parameter	Unit	Description
MD <sub>y</sub>	tCO <sub>2</sub> e	CO <sub>2</sub> equivalent of the methane captured and destroyed/ gainfully used by the project activity in year y;
MD <sub>reg,y</sub>	tCO <sub>2</sub> e	Methane emissions that would be captured and destroyed to comply with national or local safety requirements or legal regulations in the year 'y'
E <sub>LEXP, PJT, y</sub>	tCO <sub>2</sub> e	The quantity of electricity exported to the grid-connected system by this project activity during the year, y(MWh)
E <sub>LIMP, PJT, y</sub>	tCO <sub>2</sub> e	The quantity of electricity imported from grid-connected system by project activity during the year, y(MWh)
EF	tCO <sub>2</sub> e	Combined emission factor in electricity generation by grid-connected system; weighted average of EFOM and EFBM.

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

$$PE_{y, \text{electricity}} = (E_{LIMP, PJT, y} - E_{LIMP, BASE, y}) * EF$$

**E<sub>LIMP, PJT, y</sub>** The quantity of electricity imported from grid-connected system by project activity during the year, y (MWh)

**E<sub>LIMP, BASE, y</sub>** The quantity of electricity imported from grid system in baseline scenario during the year, y (MWh) (0)

**EF** is 0.6645 tCO<sub>2e</sub>/MWh and this is fixed factor during crediting period.

**E.3. Calculation of leakage**

Project emission is considered in the calculation of ER<sub>y, electricity</sub>. There is no leakage effect in this project, because this project employs new facilities to utilize landfill gas.

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

Date	ER(s) :	wCH <sub>4,y</sub>	LFG <sub>electricity,y</sub> (FLOW)	DCH <sub>4,y</sub>	GWP <sub>CH<sub>4</sub></sub>	MD <sub>reg,y</sub>	E <sub>Lexp</sub>	E <sub>Limp</sub>	CEF
2012.09.01-2012.09.30	1,195.43	47.70	167,904.00	0	21	-	248.81	0.27	0.6645
2012.10.01-2012.10.31	1,555.01	47.70	197,999.00	0	21	-	297.82	1.03	0.6645
2012.11.01-2012.11.30	1,452.13	47.70	199,905.00	0	21	-	271.21	1.07	0.6645
2012.12.01-2012.12.31	2,251.78	47.70	254,756.00	0	21	-	274.97	0.73	0.6645
2013.01.01-2013.01.31	2,463.88	47.70	306,568.00	0	21	-	321.84	0.75	0.6645
2013.02.01-2013.02.28	1,990.89	47.70	264,956.00	0	21	-	232.91	0.01	0.6645
2013.03.01-2013.03.31	2,018.58	47.70	251,578.00	0	21	-	226.39	-	0.6645
2013.04.01-2013.04.30	1,518.64	47.70	216,240.00	0	21	-	234.38	0.64	0.6645

2013.05.01-2013.05.31	3,124.70	47.70	352,113.00	0	21	-	420.87	1.26	0.6645
2013.06.01-2013.06.30	1,790.44	47.70	216,693.00	0	21	-	338.74	0.13	0.6645
2013.07.01-2013.07.31	2,120.92	47.70	234,099.00	0	21	-	396.59	0.76	0.6645
2013.08.01-2013.08.31	2,185.58	47.70	268,172.00	0	21	-	336.33	0.15	0.6645
2012.09.01-2013.08.31	23,431.20	47.70	2,930,983.00	0	21	-	3,600.87	6.79	0.6645

Item	Baseline emissions or baseline net GHG removals by sinks (tCO <sub>2</sub> e)	Project emissions or actual net GHG removals by sinks (tCO <sub>2</sub> e)	Leakage (tCO <sub>2</sub> e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO <sub>2</sub> e)
Total	23,435.71	4.51	0	23,431.20

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

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO <sub>2</sub> e)	38,740	23,431.20

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

**Actual values reached during the monitoring period: 23,431.20 tCO<sub>2</sub>e**

**Values applied in ex-ante calculation of the registered CDM-PDD (2011~2012): 38,740 tCO<sub>2</sub>e**

Comparing ex-ante calculation to actual emission reductions, actual reductions are decreased by 40%. This is because of skill-less of technology management during 1<sup>st</sup> year monitoring period and now the operational manager's operation ability has been improved.

The main reason to decrease emission reductions is below;

- New Gas collecting facilities installation
- skill-less of generator operation

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

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO <sub>2</sub> e)	6,615.33	16.815.86

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## Document information

Version	Date	Description
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory		
Document Type: Form		
Business Function: issuance		
Keywords: monitoring report, performance monitoring		