Monitoring report form for CDM project activity
(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Wonju Landfill Gas Recovery Project for Electricity Generation	
UNFCCC reference number of the project activity	10379	
Version number of the PDD applicable to this monitoring report	Version 2.1	
Version number of this monitoring report	Version 1.0	
Completion date of this monitoring report	08/08/2018	
Monitoring period number	1st monitoring period	
Duration of this monitoring period	01/06/2017~31/05/2018(365 days)	
Monitoring report number for this monitoring report	1	
Project participants	NEWGEN ELECTRICS Co., Ltd	
Host Party	Republic of Korea	
Sectoral scopes	Scope 1. Energy industry Scope 13. Waste handling and disposal	
Applied methodologies and standardized baselines	Applied methodologies: - AMS I.D: Grid connected renewable electricity generation_V18 - AMS Ⅲ. G: Landfill methane recovery_V09.0	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	-	18,029 tCO_2-eq
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	Total amount of estimated in PDD for this monitoring period: 14,546 tCO_2-eq (Amount estimated in PDD for 2017: 8,857 tCO_2-eq Amount estimated in PDD for 2018: 5,689 tCO_2-eq) * 2017:214 days, 2018: 151 days, Total: 365 days	

SECTION A. Description of project activity

A.1. General description of project activity

>Wonju Landfill Gas Recovery Project for Electricity Generation(hereafter referred to as the "Project") developed by NEWGEN ELECTRICS Co., Ltd. (hereafter referred to as "NEWGEN") is a landfill gas(LFG) recovery for power generation project at Wonju City Waste Comprehensive Treatment Complex(hereafter referred to as "Wonju landfill") in Wonju City, Gangwon Province, Republic of Korea.
Wonju landfill has been landfilled since 1995 and is composed of 3 sites. The 1st site was landfilled from 1995 to 2014 and 2nd site which succeeded 1st site has been landfilled since 2014. 3rd site is plan to be landfilled in the future.
The project site of this project was decided as the 1st site according to the business concession agreement with Wonju city.

The purpose of the project and the measures taken to reduce greenhouse gas emission:

The purpose of this project is to collect and utilize CH_4 (as a renewable energy) for electricity generation at the landfill site.

Prior to this proposed project, Wonju Landfill was emitting landfill gas (hereinafter referred to as the LFG) into the atmosphere directly without recovery and utilization of LFG. The Project captures the LFG that would have been released to the atmosphere without the project activity and generates electricity with the LFG. The generated electricity will be transmitted to the grid of Korea Electric Power Corporation (hereinafter referred to as the KEPCO grid) which is a company in charge of exclusively managing the grid of Republic of Korea.

The installed technology and equipment:

The proposed project involves the installation of a highly efficient collecting, transmitting and pre-treatment system and four electricity generators. The four generators installed with total capacity of 0.98 MW (245kW * 4set).

Total emission reduction achieved in this monitoring period:

In terms of CO_2 emission reductions, the reductions were 18,029tons CO_2 over the 12 months (365 days, 01/06/2017~31/05/2018) of crediting period.

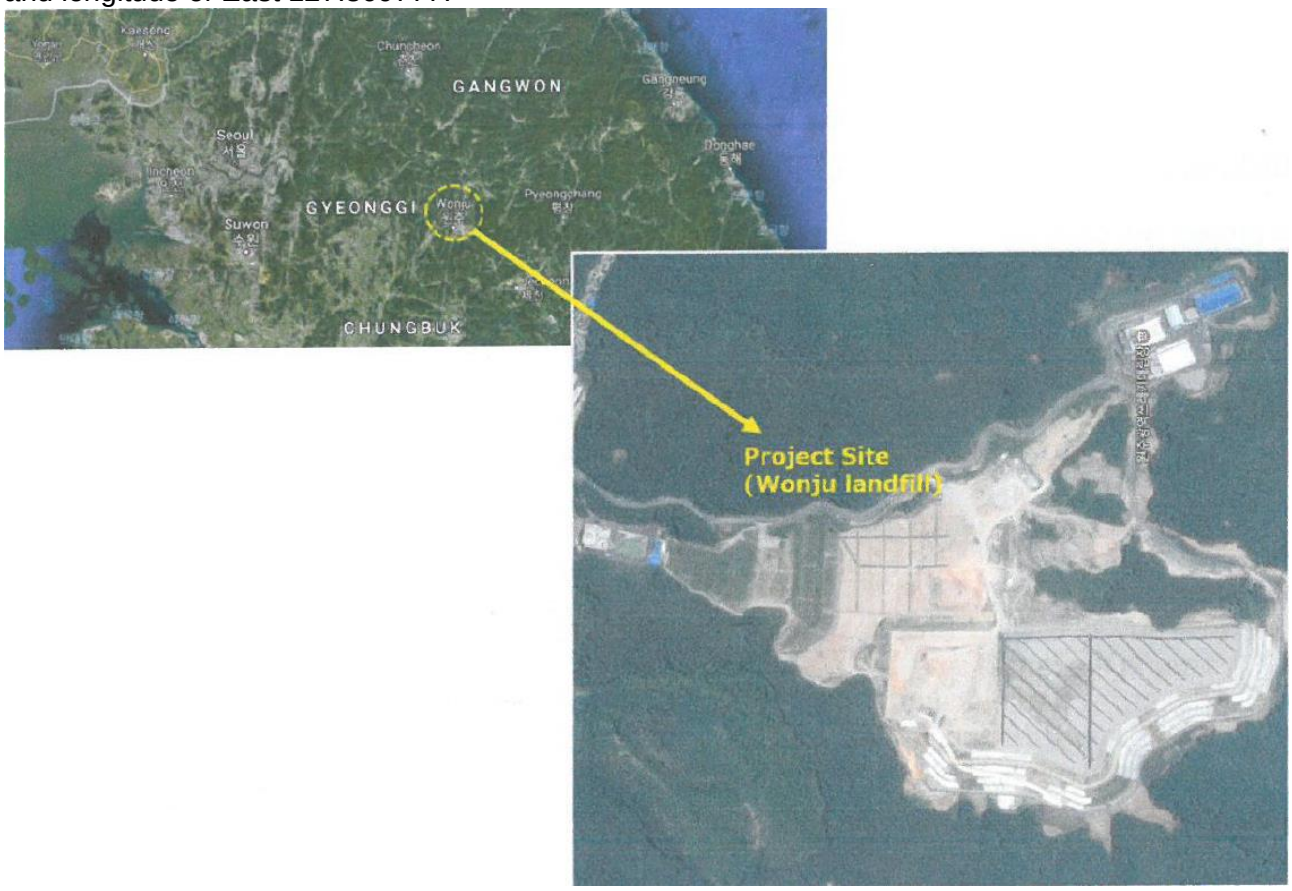
The relevant dates for the project activity:

Date	Project Schedule
07, June 2016	Permission from generation business
03, Nov 2016	Pre-inspection check of generation equipment
16, Dec 2016	Start date of operation
01, June 2017	Registered as a CDM project

A.2. Location of project activity

Host Party(ies)	Republic of Korea
Region/State/Province, etc.;	Gangwon-do
City/Town/Community, etc.;	Wonju city

The site of the "Wonju Landfill Gas Recovery Project for Electricity Generation" is located in San 185, Saje-ri, Heungeop-myeon, Wonju-city, Gangwon-do, Republic of Korea. The facilities and equipment were installed inside the Wonju landfill. The coordinates are latitude of North 37.327570 and longitude of East 127.869777.



<Figure A-1> Location of project site

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea(host)	NEWGEN ELECTRICS Co., Ltd.	No

A.4. Reference to applied methodologies and standardized baselines

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This project is a small scale project activity and conforms to Appendix B of the simplified modalities and procedures for small-scale CDM project activities.

According to Annex A of the Kyoto Protocol, this project fits in sectoral categories:
1. Energy Industry, and;
13. Waste Handling and Disposal

- Type : I – Renewable energy projects and category
  III – Other project activities and category

- Category : The approved small-scale CDM baseline methodologies;
  AMS- I.D “Grid connected renewable electricity generation” (Version 18)
  AMS-III.G “Landfill methane recovery” (Version 09.0)
- Reference : ACM0001 “Flaring or use landfill gas” (Version 17.0)
- Tools Used : “Emissions from solid waste disposal sites” (Version 08.0)
  “Tool to calculate the emission factor for an electricity system” (Version 05.0)

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A.5. Crediting period type and duration

>>
Start date: 01/06/2017
Length of crediting period: 7 years
Crediting period: 01/06/2017 ~ 31/05/2024

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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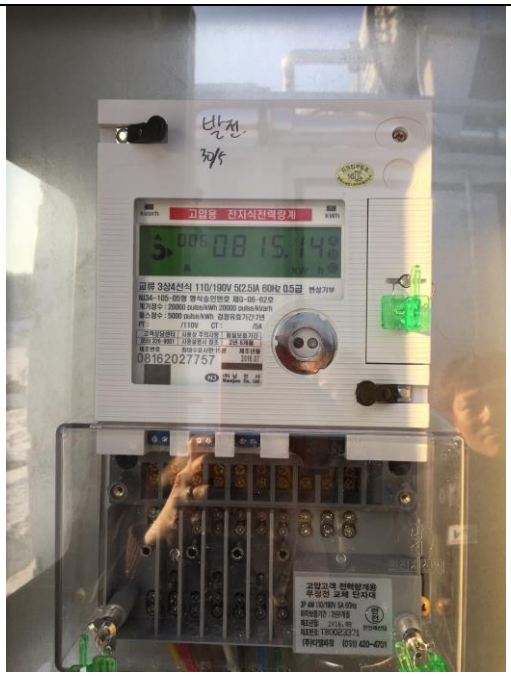
Installation of 0.98MW generator was completed and started commercial operation in June, 2017. The CDM project monitoring activity has been started since 01/06/2017. It is registered date for CDM project.

The LFG collecting equipment installed on site is described in the registered PDD. The main component is the gas collecting system.

The instruments, which are used in this project, are as below

	
<Figure B-1> The gas analyzer	<Figure B-2> The gas flow meter



<Figure B-3> The watt-hour meter(exported)

<Figure B-4> The watt-hour meter(imported)

Due to the error of equipment, there were several generator shut-downs but there was no significant event affecting 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 were several monitoring equipment maintenances but no significant malfunction was carried out in accordance with the registered PDD. And the monitoring is compliant with the monitoring plan as described in “Operating Manual-Wonju LFG Power Plant”.

And once the monitoring system error occurs, the employee who worked at the time has recorded an hourly work log on the flow rate and CH_4 concentration.

The details of operation events during this monitoring period are as follows:

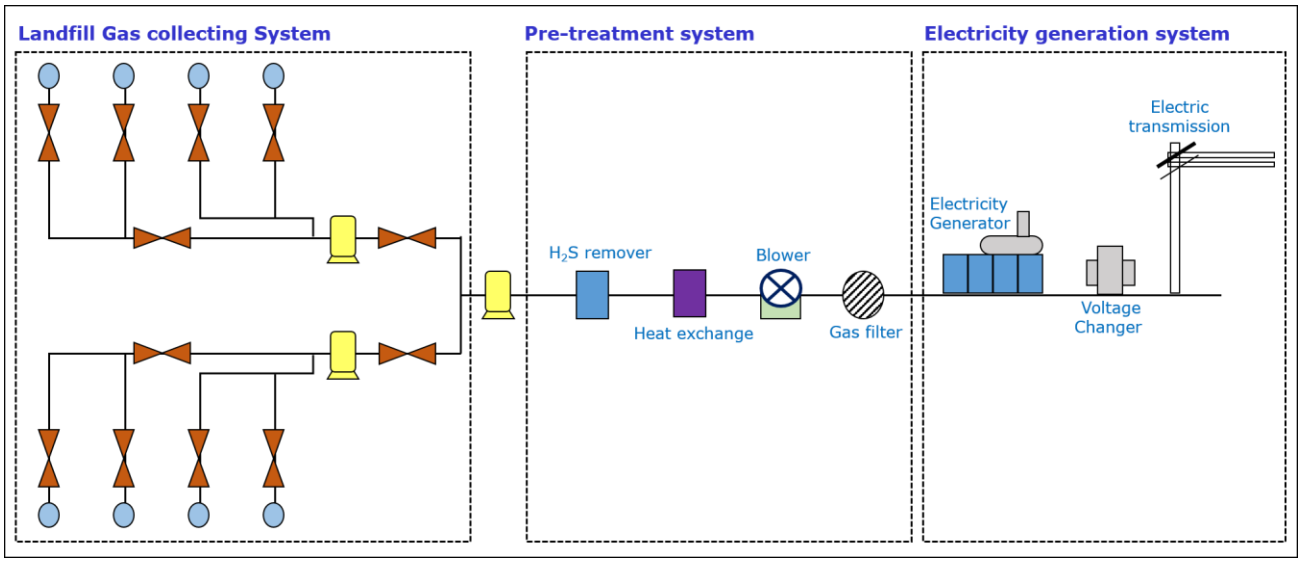
<Table B-1>Operation events history

Date	duration	Operation events	Note
170618	1hr	Error of equipment	Due to the Oxygen mixed, 1st, 4th generator shut down
170619	8hrs	Error of equipment	Due to the Oxygen mixed, 1st, 4th generator shut down
170708	1hr	Maintenance of facilities	The engine oil is replaced
170727	5hrs	Maintenance of facilities	The cooling water pipe is replaced
170728	14hrs	Error of equipment	Due to the mix-position control error, 2nd generator shut down
170804	7hrs	Error of equipment	2nd generator shut down
170806	9hrs	Error of equipment	2nd generator shut down
170809	3hrs	Error of equipment	2nd generator shut down
170811	1hr	Error of equipment	2nd generator shut down
170813	1hr	Error of equipment	2nd generator shut down
170830	1hr	Maintenance of facilities	ventilator is installed
171006	5hrs	Error of equipment	1st generator shut down

171009	24hrs	Monitoring system error	the data was recorded by hourly work log
171024	3hrs	Monitoring system error	the data was recorded by hourly work log
	14hrs	Monitoring system error	the data was recorded by hourly work log
171029	24hrs	Monitoring system error	the data was recorded by hourly work log
171208	2hr	Error of equipment	Due to the technical problem of the flow meter, it didn't recorded
171211	9hrs	Monitoring system error	the data was recorded by hourly work log
171212	4hrs	Error of equipment	2nd generator shut down
171213	1hr	Error of equipment	4th generator shut down
180115	2hrs	Error of equipment	Due to the leaking of the cooling water, 1st , 3rd generator shut down
180116	8hrs	Error of equipment	Due to the leaking of the cooling water, 1st , 3rd generator shut down
180124	8hrs	Error of equipment	1st generator shut down
180226	5hrs	Error of equipment	1st generator shut down
180311	2hrs	Error of equipment	1st , 3rd generator shut down
180315	1hr	Error of equipment	1st generator shut down
180316	7hrs	Error of equipment	Due to the flow meter malfunction, data is not recorded
180415	24hrs	Monitoring system error	the data was recorded by hourly work log
180429	24hrs	Monitoring system error	the data was recorded by hourly work log

· The description of the technology

The main process of the project is a landfill gas collecting system, a landfill gas pre-treatment system and an electricity generation system. The best available technology for each process of collecting and recycling LFG effectively is adopted into the this project.



<Figure B-5> The main process of the this project

The main features of the LFG facilities are presented below.

· Landfill Collecting System

The landfill gas collection system consists of the following elements
- Vertical gas wells that extract the landfill gas from the landfill;

- Gas pipes that collect and transport the extracted gas to the power plant;
- Blowers which draw the gas from the wells through the collecting system and deliver it to gas fueled power generation units.

The type of LFG collecting system is expected to enhance maintenance and LFG collecting efficiency because vertical collecting system has higher collecting efficiency and is easier to maintain and repair system compared to the horizontal collecting system.

· Landfill Gas Pre-treatment System

Prior to combustion in the power generation units, the LFG will be treated in a pre-treatment unit: to remove condensed water by using the Condensation Separate Vessel (CSV) tank, removing moisture of the gas through a heat exchanger, then after removing sulfur through the desulfurization and removing dust in gas filter put it into the generator.

Condensation Separate Vessel (CSV)	Condensed water removal
▼	
H_2S remover	Desulfurization
▼	
Exchange and Chiller	Gas temperature control/water removal
▼	
Blower	Gas Inhalation into the generator
▼	
Gas Filter	Dust Removal

<Figure B-6> The process of pre-treatment system

· Generation System

This project is designed to install the four generators with total capacity of 980kW (245kW * 4set) inside the Wonju landfill. The collected LFG is sent to the generator and the electricity generated is exported to the grid-connected system of the Korea Electric Power Corporation (KEPCO) supply system.

<Table B-2> The technical data of power generator based on full load

Engine	Manufacture	Doosan Infracore Co., Ltd.
	Model	GV180TI
	Engine Type	V-type 4 cycle, water cooled Turbo charged & intercooled (water to air)
Generator	Manufacture	HANATECH
	Model	BDS-245
	Type	Container Type Landfill Gas
	Maximum Electrical Power Output (kW)	245
	Voltage (V)	380
	Frequency (Hz)	60
	Speed (rpm)	1,800

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

>>
N/A

B.2.2. Corrections

>>
N/A

B.2.3. Changes to the start date of the crediting period

>>
N/A

B.2.4. Inclusion of monitoring plan

>>
N/A

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

>>
N/A

B.2.6. Changes to project design

>>
N/A

SECTION C. Description of monitoring system

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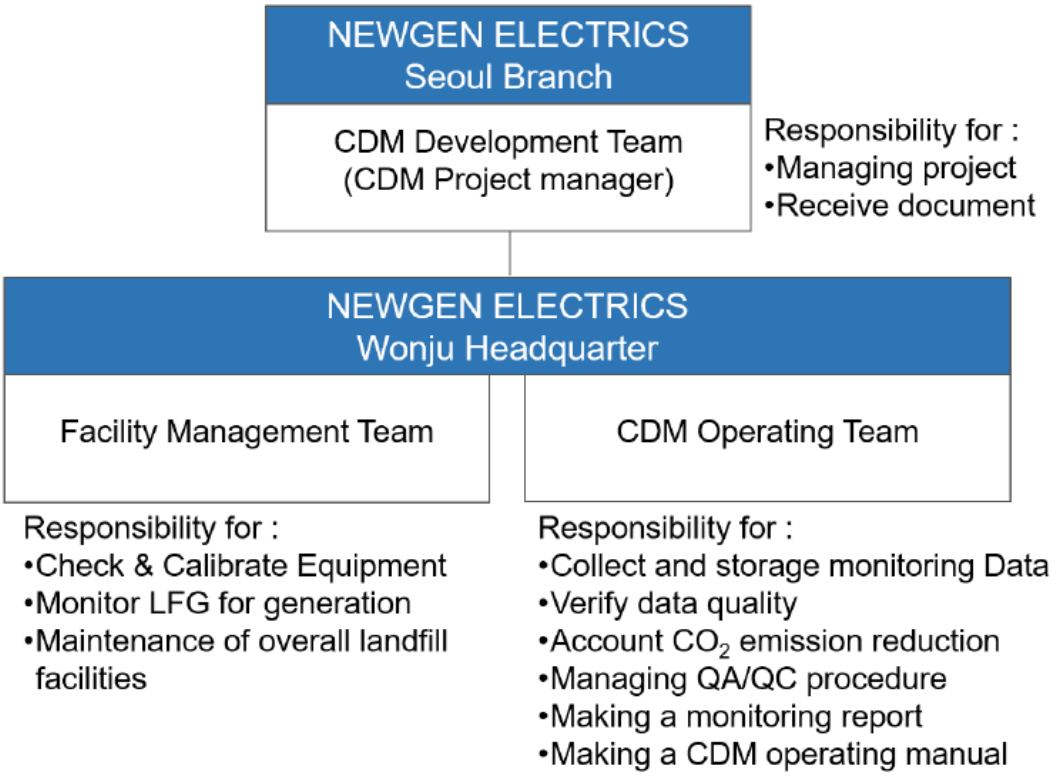
Monitoring data and parameters are monitored and their measurement method is referred to "Operating Manual-Wonju LFG Power Plant". The relevant document has been submitted to the DOE.
Data and parameters are provided in Section D.

Monitoring organization and the role of each party
The following figure describes the operation and management structure for monitoring of the project activity. Below table shows the responsible party for each task of monitoring.



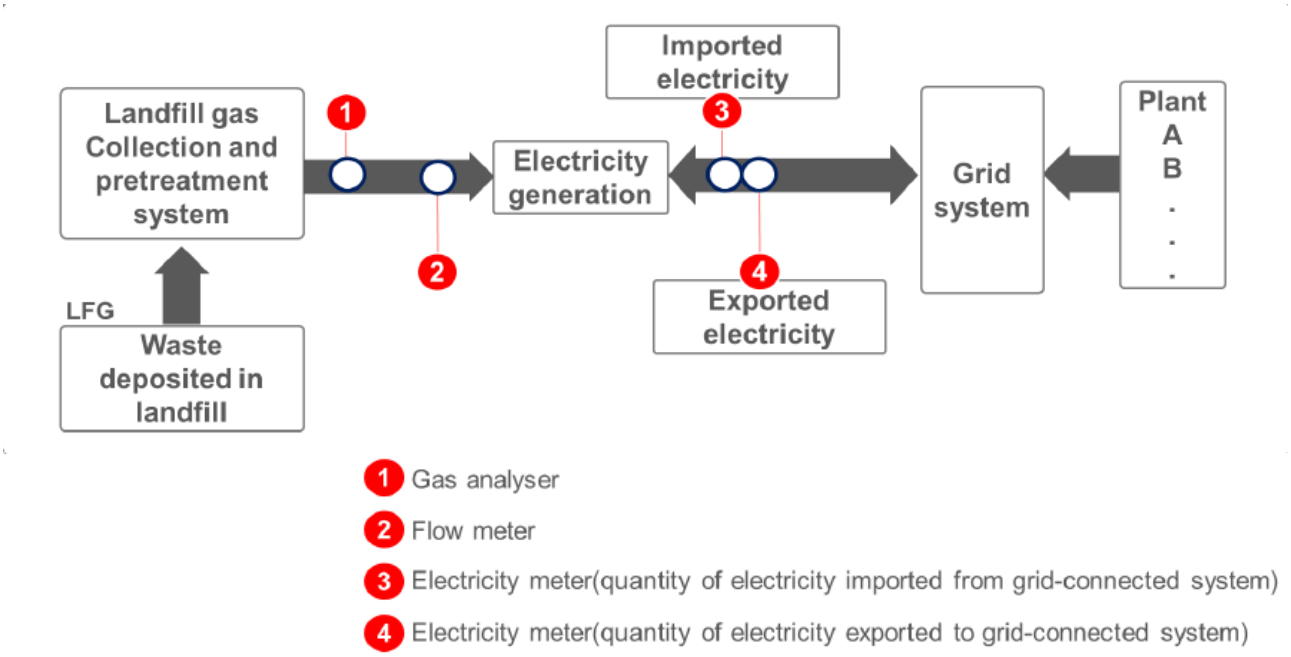
<Figure C-1> The structure of monitoring system

<Table C-1> The responsible party for each task of monitoring

Item	Sub-item	Responsible person
Measure & Achieve	$EG_{PJ,facility,y}$	CDM Operating Team
	$LFG_{i,y}$	
	$w_{CH4,y}$	
Measuring instrument check & Calibration	Centralized monitoring system	Facility Management Team
	Flow meter	
	Gas analyzer	
	Electricity meters	Facility Management Team Korea Electric Power Corporation
Establish monitoring plan		CDM Operating Team
Monitoring report		CDM Operating Team

The monitoring equipment to measure the amount of methane and electricity

- Gas flow meter is installed between the blower and generating facility to measure LFG flow amount, automatically corrected temperature and pressure.
- CH_4 analyzer is located before the above flow meter to measure the fraction of methane in LFG volume fed into the gas engine. that will be carried out close to the location in the system where the LFG flow, temperature and pressure measurements take place, and at the same humidity content basis.
- Electricity meters are installed behind the generator and sealed up after affirmation of KEPCO.



<Figure C-2> The Location of the Monitoring facilities

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

LFG CDM Project manager is the responsible person for quality management, which ensures the quality and accuracy of the measured data. For quality management, the following items are included: data records and storage, equipment calibration and maintenance, corrective action and emergency procedures for unintended emissions.

- The amounts of the quantity of electricity exported(a) by the project plant and the imported(b) to the project is measured by each certified meter. The quantity of electricity exported(a) is reported by KEPCO meterman visiting at once a month the Wonju landfill. The measured data (b) are transferred to KEPCO and are checked and achieved monthly in electronic way by Wonju CDM Operating team.
- Gas flow meter are subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.
- CH_4 analyzer is subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.
- Electricity meters are subject to a regular maintenance and testing to ensure accuracy. The calibration frequency of the meter measuring electricity exported to the grid will be in accordance with the “Regulation on operation of electricity market”. The calibration frequency of the meter measuring electricity imported from the grid will be in accordance with the “ENFORCEMENT DECREE OF MEASURES ACT”.

Data records and storage:

The measured data is archived in electronic file or documented in paper.
All data must be accurate and must be kept for two years after the end of the last monitoring period. CDM operating team should check them continuously.

Equipment calibration and maintenance:

Calibration of equipment consists of verifying, by comparison with a standard, the accuracy of a measuring instrument. Measuring instruments will be periodically and appropriately calibrated according to the procedures, timing and methods recommended by the manufacturer, or national/international standards, as available.

- Gas flow meter are subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.
- CH_4 analyzer is subject to a regular maintenance and testing regime to ensure accuracy according to “Operating Manual-Wonju LFG Power Plant related CDM project”.
- Electricity meters are subject to a regular maintenance and testing to ensure accuracy. The calibration frequency of the meter measuring electricity exported to the grid will be in accordance with the “Regulation on operation of electricity market”. The calibration frequency of the meter measuring electricity imported from the grid is in accordance with the “ENFORCEMENT DECREE OF MEASURES ACT”.

Corrective action

LFG plant manager will report all issues and data related to plant operation to LFG CDM project manager (Green & Renewable energy business team).
Operation review, internal audit and corrective action are carried out by Green & Renewable energy business team according to the “Wonju LFG Power Plant Operation Manual”.

Emergency procedure:

In case of emergency situation, proper action is carried out to minimize damage in accordance with “Wonju LFG Power Plant Operation Manual”.

Training

Employees involved in the monitoring took training internally on the overall CDM project activity,

External training for emissions trading scheme was done by experts (from consulting company) on November 28, 2017. Internal training for the monitoring was done by LFG CDM project manager of headquarter on November 28, 2017.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data / Parameter	D_{CH4}
Unit	tCH_4/m^3CH_4
Description	Methane density
Source of data	"Tool to determine project emissions from flaring" Version 02 (EB 68 Annex 15)
Value(s) applied	0.0007168
Choice of data or Measurement methods and procedures	At standard temperature and pressure (0 degree Celsius and 1.013bars), the density of methane is 0.0007168 t/m^3
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	GWP_{CH4}
Unit	tCO_2e/tCH_4
Description	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data	Decisions under the UNFCCC and the Kyoto Protocol (a value of 25 is to be applied for the second commitment period of the Kyoto Protocol) As per EB 69 Report Annex 3 and IPCC 2007 - Climate Change 2007: Working Group I: The Physical Science Basis (Contribution to Fourth Assessment Report of IPCC), Chapter 2, Table 2.14
Value(s) applied	25
Choice of data or Measurement methods and procedures	Default Global Warming potential of Methane
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	OX
Unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Based on an extensive review of published literature on this subject, including the IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	Default value "Emissions from solid waste disposal sites" version 08.0
Purpose of data	Estimated as baseline emissions
Additional comment	When methane passes through the top-layer, part of it is oxidized by methanotrophic bacteria to produce CO_2. The oxidation factor represents the proportion of methane that is oxidized to CO_2. This should be distinguished from the methane correction factor (MCF) which is to account for the situation that ambient air might intrude into the SWDS and prevent methane from being formed in the upper layer of SWDS.

Data / Parameter	$EG_{m,y}$
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid by power unit m in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	-
Choice of data or Measurement methods and procedures	$EG_{m,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$FC_{i,m,y}$
Unit	Mass or volume unit
Description	Amount of fuel type i consumed by power unit m in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	-
Choice of data or Measurement methods and procedures	$FC_{i,m,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$NCV_{i,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source Values provided by the fuel supplier of the power plants in invoices / If data is collected from power plant operators (e.g. utilities) Regional or national average default values / If values are reliable and documented in regional or national energy statistics/energy balances IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories As per "2013~2015 Statistics of Electric Power in Korea" provided by KEPCO, $NCV_{i,y}$ values provided by the national energy statistics
Value(s) applied	values provided by the national energy statistics
Choice of data or Measurement methods and procedures	$NCV_{i,y}$ should be determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions Calculation of project emissions
Additional comment	-

Data / Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	CO_2 emission factor of fuel type i used in power unit m in year y
Source of data	"Tool to calculate the emission factor for an electricity system" Version 05.0 The following data sources may be used if the relevant conditions apply: Data source / Conditions for using the data source Values provided by the fuel supplier of the power plants in invoices / If data is collected from power plant operators (e.g.utilities) Regional or national average default values / If values are reliable and documented in regional or national energy statistics/energy balances IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories Emission factor by fuel in "Guideline for the greenhouse gas target management system(2016.12.30)", $EF_{CO2,i,y}$ values provided by the national average default values
Value(s) applied	National average default values
Choice of data or Measurement methods and procedures	$EF_{CO2,m,i,y}$ is determined either once for each crediting period using the most recent three historical years for which data is available at the time of submission of the CDM-PDD to the DOE for validation (ex ante option)
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	$EF_{OM,y}$
Unit	tCO_2/MWh
Description	Operating margin CO_2 emission factor for the project electricity system in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	0.7403
Choice of data or Measurement methods and procedures	The simple OM method is used to calculate EF_{OM} in accordance with the guidance of AMS-I.D which allows the above method where low-cost/must-run resources constitute less than 50% of total grid generation. The generating sources do not include low-cost and must-run plant in conformity with the direction of AMS-I.D EF_{OM} is calculated using the data for the most recent 3 years (2013~2015) for which data are available at time of this PDD submission, and fixed for the crediting period.
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	$EF_{BM,y}$
Unit	tCO_2/MWh
Description	Build margin CO_2 emission factor for the project electricity system in year y
Source of data	"2013~2015 Statistics of Electric Power in Korea"
Value(s) applied	0.5644

Choice of data or Measurement methods and procedures	EF_{BM} is calculated ex ante based on the most recent information available on plants already built for sample group at this PDD submission. According to AMS-I.D, the sample group consists of either the five power plants that have been built most recently or the power plant capacity additions in the electricity system that comprise 20% of the system generation and that have been built most recently. In this project, the latter is selected because project participant has to select the sample group that comprise the larger annual generation in guidance with the direction of AMS-I.D the value EF_{BM} is fixed for the crediting period.
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	$EF_{grid,y}$
Unit	tCO_2/MWh
Description	CO_2 emission factor of the grid electricity in year y
Source of data	Calculated
Value(s) applied	0.6523
Choice of data or Measurement methods and procedures	The baseline emission factor ($EF_{grid,y}$) is calculated as the weighted average of the simple OM emission factor ($EF_{grid,OM,y}$) and the BM emission factor ($EF_{grid,BM,y}$). By default, both margins have equal weights (50%)
Purpose of data	Estimated as baseline emissions
Additional comment	-

D.2. Data and parameters monitored

Data/Parameter	$W_{CH4,y}$
Unit	%, volume basis(m^3 CH_4/m^3 LFG)
Description	Methane content in landfill gas in the year y
Measured/calculated/default	Measured
Source of data	Measured by using a methane analyzer(measuring methane content directly)
Value(s) of monitored parameter	**Date**: 01/06/2017~31/05/2018; **Measured CH_4 (%) (Weighted average CH_4 concentration)**: 51.593
Monitoring equipment	**Tag** / $W_{CH4,y}$: Serial No: 34001096; Accuracy level: 0.5% abs. or 5% rel.; Type: stationary gas analyzer; Calibration frequency: 2 years; Date of last calibration: 09/09/2016; Validity: 08/09/2018
Measuring/reading/recording frequency	Measuring frequency : continuously Recording frequency : hourly
Calculation method (if applicable)	Weighted average CH_4 concentration
QA/QC procedures	Gas analyzer will be subject to maintenance and calibration according to manufacturer recommendations. Span and Zero calibration will be accomplished by means of reference gas(mixture calibration gas) bottles, which will be available at the plant.
Purpose of data/parameter	Calculation of baseline emissions(ex post)
Additional comments	The methane content measurement is carried out close to the location in the system where the landfill gas flow, temperature and pressure measurements take place, and at the same humidity content basis.

Data/Parameter	$LFG_{i,y}$
Unit	m^3
Description	Landfill gas destroyed via combustion in power plant in year y
Measured/calculated/ default	Measured
Source of data	Measured by using gas flow meter.

Value(s) of monitored parameter:

Data	LFGi,y
01/06/2017-30/06/2017	304,155.000
01/07/2017-31/07/2017	191,023.000
01/08/2017-31/08/2017	174,548.000
01/09/2017-30/09/2017	247,005.000
01/10/2017-31/10/2017	183,246.000
01/11/2017-30/11/2017	229,303.000
01/12/2017-31/12/2017	188,296.000
01/01/2018-31/01/2018	147,503.000
01/02/2018-28/02/2018	184,142.000
01/03/2018-31/03/2018	185,402.000
01/04/2018-30/04/2018	186,980.000
01/05/2018-31/05/2018	247,181.000
01/06/2017~31/05/2018	2,468,784.000

Monitoring equipment	<table><tr><th>Tag</th><th>$LFG_{i,y}$</th></tr><tr><td>Serial No</td><td>K-1609083</td></tr><tr><td>Accuracy level</td><td>±0.5% of F.S</td></tr><tr><td>Type</td><td>Gas Flow Meter</td></tr><tr><td>Calibration frequency</td><td>3 years</td></tr><tr><td>Date of last calibration</td><td>20/09/2016</td></tr><tr><td>Validity</td><td>19/09/2019</td></tr></table> The LFG combusted in power plant is monitored by a continuous thermal gas mass flow meter, the readings is compensated for normal pressure and temperature values.
Measuring/reading/recording frequency	Measuring frequency : continuously Recording frequency : hourly
Calculation method (if applicable)	Not applied
QA/QC procedures	The gas flow meter is subject to a regular maintenance and testing, to ensure accuracy. The gas flow meter e subject to maintenance and calibration according to is manufacturer recommendations.
Purpose of data/parameter	Calculation of baseline emissions(ex post)
Additional comments	-

Data/Parameter	$EG_{PJ,facility,y}$
Unit	MWh
Description	Total amount of net electricity exported to grid-connected system.
Measured/calculated/default	Measured
Source of data	Electricity meter records

Value(s) of monitored parameter

a) the quantity of electricity exported by the project plant/unit to the grid

Date	Measured $EG_{PJ,facility,y}$ (MWh)
01/06/2017-30/06/2017	277.006
01/07/2017-31/07/2017	200.484
01/08/2017-31/08/2017	179.698
01/09/2017-30/09/2017	228.679
01/10/2017-31/10/2017	202.867
01/11/2017-30/11/2017	230.810
01/12/2017-31/12/2017	168.811
01/01/2018-31/01/2018	168.142
01/02/2018-28/02/2018	192.190
01/03/2018-31/03/2018	200.585
01/04/2018-30/04/2018	176.724
01/05/2018-31/05/2018	221.328
01/06/2017 ~ 31/05/2018	**2,447.324**

(b) the quantity of electricity imported to the project plant/unit from the grid.

Date	Measured $EG_{PJ,facility,y}$ (MWh)
15/05/2017~14/06/2017	0.080
15/06/2017~14/07/2017	0.173
15/07/2017~14/08/2017	0.526
15/08/2017~14/09/2017	0.050
15/09/2017~14/10/2017	0.057
15/10/2017~14/11/2017	0.000
15/11/2017~14/12/2017	0.144
15/12/2017~14/01/2018	0.000
15/01/2018~14/02/2018	0.266
15/02/2018~14/03/2018	0.072
15/03/2018~14/04/2018	0.007
15/04/2018~14/05/2018	0.000
15/05/2018~14/06/2018	0.014
01/06/2017-31/05/2018	**1.389**

Monitoring equipment

Tag	$EG_{PJ,facility,y}$	
	Electricity meter (exported)	Electricity meter (imported)
Serial No	08162027757	05131020188
Accuracy level	±0.5s	±1s
Type	Watt-hour meter	Watt-hour meter

Measuring/reading/recording frequency

Measuring frequency : Continuously
Recording frequency : Monthly

Calculation method (if applicable)

This parameter is either monitored using each electricity meter and calculated as difference between (a) the quantity of electricity exported by the project plant/unit to the grid; and (b) the quantity of electricity imported to the project plant/unit from the grid.

QA/QC procedures

Electricity meters are subject to a regular maintenance and testing to ensure accuracy.
Electricity meter for (a) is calibrated regularly in accordance with the "Regulation on operation of electricity market".
Electricity meter for (b) is calibrated every 7 years in accordance with "ENFORCEMENT DECREE OF MEASURES ACT".
The value is cross-checked with the invoice from KEPCO.

Purpose of data/parameter

Calculation of baseline emissions(ex post)

Additional comments

-

D.3. Implementation of sampling plan

>>
N/A

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

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$BE_y = BE_{CH4,y} + BE_{electricity,y}$

Parameter	Unit	Description
BE_y	tCO_2e	Baseline emission for in year y
$BE_{CH4,y}$	tCO_2e	Baseline emission from LFG avoidance that otherwise would be emitted to the atmosphere in absence of the Project in year y(tCO_2e) which is estimated as per AMS-Ⅲ.G
$BE_{electricity,y}$	tCO_2e	Baseline emission from electricity displacement that otherwise would be provided by grid in year y (tCO_2e) which is estimated as per AMS-I.D

Baseline emission from LFG avoidance ($BE_{CH4,y}$):

$BE_{CH4,y} = \eta_{PJ} \times BE_{CH4,SWDS,y} - (1\text{-}OX) \times F_{CH4,BL,y} \times GWP_{CH4}$

Baseline emission from electricity displacement ($BE_{electricity,y}$):

$BE_{electricity,y} = EG_{PJ,y} \times EF_{grid,y}$

E.2. Calculation of project emissions or actual net removals

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$PE_y = PE_{power,y} + PE_{flare,y} + PE_{process,y}$

Parameter	Unit	Description
PE_y	tCO_2e	Project emissions in year y
$PE_{power,y}$	tCO_2e	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y
$PE_{flare,y}$	tCO_2e	Emissions from flaring or combustion of the landfill gas stream in the year y
$PE_{process,y}$	tCO_2e	Emissions from the landfill gas upgrading process in the year y, determined by following the relevant procedures described in annex 1 of AMS-III.H

CEF is 0.6523 tCO_2e/MWh and this is fixed factor during the crediting period.

$PE_y = PE_{power,y}$

Project emissions consist of CO_2 emissions related to the power used by this project facility.

E.3. Calculation of leakage emissions

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There is no leakage effect in this project.

E.4. Calculation of emission reductions or net anthropogenic removals

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	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	18,030.441	0.906	0	0	18,029.535	18,029

The actual emission reduction achieved by the project activity during the crediting period will be calculated using the amount of methane recovered and destroyed/gainfully used by the project activity and electricity displacement by the project activity, calculated as:

$$ER_{y,calculated} = (1 - OX) \times (F_{CH4,PJ,y} - F_{CH4,BL,y}) \times GWP_{CH4} + (EG_{PJ,facility,y} \times EF_{grid,y}) - LE_y$$

Parameter	Unit	Description
$ER_{y,calculated}$	tCO_2e	Emission reduction from both methane destruction and grid displacement
OX	-	Oxidation factor (reflecting the amount of methane from SWDS that is oxidised in the soil or other material covering the waste) (dimensionless). A default value of 0.1 may be used
$F_{CH4,PJ,y}$	tCH_4	Methane captured and destroyed/gainfully used by the project activity in the year
$F_{CH4,BL,y}$	tCH_4	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year (tCH_4). The relevant procedures in "ACM0001: Flaring or use of landfill gas" may be followed, as well as taking into account the compliance with the relevant local laws and regulation if such laws and regulations exist
GWP_{CH4}	-	Global Warming Potential for methane (value of 25)
$EG_{PJ,facility,y}$	MWh	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
$EF_{grid,y}$	tCO_2e/MWh	CO_2 emission factor of the grid electricity in year y
LE_y	tCO_2e	Leakage emissions from both methane destruction and grid displacement

The values for this monitoring period are:

Period	$ER_{y,calculated}$	OX	$F_{CH4,PJ,y}$	$F_{CH4,BL,y}$	GWP_{CH4}	$EG_{PJ,facility,y}$ (a)	$EG_{PJ,facility,y}$ (b)	$EF_{grid,y}$	LE_y
	tCO_2e	-	tCH_4	tCH_4	-	MWh	MWh	tCO_2e/ MWh	tCO_2e
01/06/2017 ~ 31/05/2018	18,029.535	0.100	913.003	182.601	25	2,447.324	1.389	0.6523	0

Determination of $F_{CH4,PJ,y}$:

Methane captured and destroyed/gainfully used by the project activity($F_{CH4,PJ,y}$) may be calculated as follows, based on monitoring methane flow and concentration :

$$F_{CH4,PJ,y} = D_{CH4,y} \times w_{CH4,y} \times \sum_i LFG_{i,y}$$

Parameter	Unit	Description
$F_{CH4,PJ,y}$	tCH_4	Methane captured and destroyed/gainfully used by the project activity in the year
$D_{CH4,y}$	tonnes/m^3	Density of methane at the temperature and pressure of the landfill gas in year. If $LFG_{i,y}$ is reported at normal conditions of temperature and pressure, the density of methane is also determined at normal conditions
$W_{CH4,y}$	m^3CH_4/m^3LFG	Methane content in landfill gas in year. Landfill gas composition shall be measured either on a dry basis or at the same humidity as used to determine $LFG_{i,y}$
$LFG_{i,y}$	m^3LFG	Landfill gas destroyed via method i (flaring, fuelling, combustion, injection to a grid, etc.) in year. The flow or volume measurement shall be made either on a dry basis or at the same humidity as $w_{CH4,y}$

The values for this monitoring period are:

Period	$F_{CH4,PJ,y}$	$D_{CH4,y}$	$W_{CH4,y}$	$LFG_{i,y}$
	tCH_4	tonnes/m^3	m^3CH_4/m^3LFG	m^3LFG
01/06/2017 ~ 31/05/2018	913.003	0.0007168	51.593	2,468,784.000

Determination of $F_{CH4,BL,y}$:
$F_{CH4,BL,y}$ was determined using the methodology ACM0001.

According to the article 7 on “ENFORCEMENT DECREE OF THE WASTES CONTROL ACT”, a landfill has facilities for gas incineration(such as simple burning system)or power generation and fuel-making are required in order to prevent surrounding environment problem(e.g. air pollution, odour, etc.). A significant amount of LFG generated at the Wonju landfill was released to atmosphere even though the LFG is captured partially and combusted by the simple incineration facility.

Hence, $F_{CH4,BL,y}$ as per table 3 of ACM0001 “Flaring or use of landfill gas” is applicable Case 4(i.e., Requirement to destroy methane exists and LFG capture system exists).

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	**Yes**	**Yes**

According to Case 4 in the ACM0001, $F_{CH4,BL,y}$ was determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y};F_{CH4,BL,sys,y}\}$

Parameter	Unit	Description
$F_{CH4,BL,R,y}$	tCH_4/yr	Amount of methane in the LFG which is flared in the baseline due to a requirement in year y
$F_{CH4,BL,sys,y}$	tCH_4/yr	Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system

$F_{CH4,BL,R,y}$ and $F_{CH4,BL,sys,y}$ were determined according to the respective procedures for Case 2 and Case 3 in ACM0001.

In accordance with procedure in ACM0001, $F_{CH4,BL,y}$ was determined, as follows:

$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y};F_{CH4,BL,sys,y}\} = 0.2 \times F_{CH4,PJ,,y}$

The values for this monitoring period are:

Period	$F_{CH4,PJ,y}$	$F_{CH4,BL,y}$
	tCH_4	tCH_4
01/06/2017 ~ 31/05/2018	913.003	182.601

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (tCO_2e)	Amount estimated ex ante (tCO_2e)
18,029	14,546

E.6. Remarks on increase in achieved emission reductions

>>

Actual values reached during the monitoring period: 18,029 tCO_2e
Values applied in ex-ante calculation of the registered CDM-PDD: 14,546 tCO_2e
The emission reductions increased to 23.9% during the monitoring period compared to the expected emission reductions which are on the registered CDM-PDD.
The main causes of the increased emission reductions are as follows.

CH_4 concentration
The PDD estimate was based on 50% CH_4 concentration but the actual concentration exceeds 51.593% in this monitoring period.
The change of waste composition and maintenance for landfill is the biggest contributor for increase in CH_4 concentration.

Seasonal effect
Rain interrupts LFG emitting to atmosphere through cover soil layer. There were lots of torrential rain and abnormally high temperatures with humidity in the monitoring period especially in summer.

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

Project participant and/or responsible person/ entity	☒ Project participant ☒ Person/entity responsible for completing the CDM-MR-FORM
Organization name	NEWGEN ELECTRICS Co., Ltd.
Street/P.O. Box	116, Suruni-gil, Saje-ri, Heungeop-myeon
Building	-
City	Wonju
State/region	Gangwon-province
Postcode	26356
Country	Republic of Korea
Telephone	82-(0)70-5099-0296
Fax	82-(0)70-5099-0297
E-mail	wonsh@newgen-el.com
Website	-
Contact person	Seung Hyun, Won
Title	Manager
Salutation	Mr.
Last name	Won
Middle name	-
First name	Seung Hyun
Department	CDM project manager
Mobile	-
Direct fax	82-(0)70-5099-0297
Direct tel.	82-(0)70-5099-0296
Personal e-mail	wonsh@newgen-el.com

Appendix 2. Emission reduction calculation

An excel book containing monitored data and calculations of baseline emissions, project emissions and emission reductions and additional checks and information is attached:

- (ER 1th)Wonju LFG to Energy Project_ver.1.0_180807