



**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**

<b>Title of the project activity</b>	Wonju Landfill Gas Recovery Project for Electricity Generation	
<b>UNFCCC reference number of the project activity</b>	10379	
<b>Version number of the PDD applicable to this monitoring report</b>	Version 3.0	
<b>Version number of this monitoring report</b>	Version 1.0	
<b>Completion date of this monitoring report</b>	07/05/2019	
<b>Monitoring period number</b>	NA	
<b>Duration of this monitoring period</b>	17/07/2018~30/04/2019 (288 days)	
<b>Monitoring report number for this monitoring report</b>	1	
<b>Project participants</b>	NEWGEN ELECTRICS Co., Ltd	
<b>Host Party</b>	Republic of Korea	
<b>Sectoral scopes</b>	Scope 1. Energy industry Scope 13. Waste handling and disposal	
<b>Applied methodologies and standardized baselines</b>	Applied methodologies: - AMS I. D: Grid connected renewable electricity generation_V18 - AMS III. G: Landfill methane recovery_V09.0	
<b>Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period</b>	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	-	15,085tCO <sub>2</sub> e
<b>Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD</b>	Total amount of estimated in PDD for this monitoring period: 11,526 tCO <sub>2</sub> e (Amount estimated in PDD for 2018: 6,992 tCO <sub>2</sub> e Amount estimated in PDD for 2019: 4,534 tCO <sub>2</sub> e) * 2018:168 days, 2019: 120 days, Total: 288 days	

## **SECTION A. Description of project activity**

### **A.1. General description of project activity**

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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 1<sup>st</sup> site was landfilled from 1995 to 2014 and 2<sup>nd</sup> site which succeeded 1<sup>st</sup> site has been landfilled since 2014. 3<sup>rd</sup> site is plan to be landfilled in the future.

The project site of this project was decided as the 1st and 2nd sites according to the business concession agreement with Wonju city. NEWGEN has estimated emission reductions using amounts of LFG collected in 1st which was landfilled until 2014 and 2nd site which has been landfilled since 2014. The objective of this project is to capture LFG and generate electricity. The project is aimed at reducing atmospheric emissions of methane, a greenhouse gas (GHG) which contributes to global warming and climate change.

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

The objective of this project is to capture LFG and generate electricity. The project is aimed at reducing atmospheric emissions of methane, a greenhouse gas (GHG) which contributes to global warming and climate change.

Prior to this proposed project, 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. 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 was 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.

#### ***Description of the installed technology and equipment***

The main process of the project is a landfill gas collecting system, a landfill gas pre-treatment system and an electricity generation system. The 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 0.98MW (0.170MW×3set, 0.470MW×1set).

2 or 3 of the four generators are operated depending on the amount of the gas, the CH<sub>4</sub> concentration, the condition of the generator, and the seasonal conditions. In addition, all generators are always maintained at regularly and operated alternately according to the maintenance status.

The project activity is significantly contributing to a reduction in GHG emissions while at the same time improving local air quality and mitigating some of the existing environmental impacts affecting people working and/or living in the vicinity of the landfill sites.

#### ***Total emission reduction achieved in this monitoring period***

Total GHG emission reductions in this monitoring period (17/07/2018-30/04/2019) are 15,085 tCO<sub>2</sub>e.

**The relevant dates for the project activity**

&lt;Table A-1&gt; Operation activity

Date	Project Schedule
07/06/2016	Permission from generation business
17/10/2016	Began commercial operation
03/11/2016	Completed pre-operational inspection (commercial operation and selling electricity) check of generation equipment)
16/12/2016	Reported of opening a business
01/06/2017	Registered as a CDM project

**A.2. Location of project activity**

&gt;&gt;

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°.



&lt;Figure A-1&gt; Location of project site

**A.3. Parties and project participants**

&gt;&gt;

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**

&gt;&gt;

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

**Methodology**

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)
- “Tool to determine project emissions from flaring” (Version 02.0)

**A.5. Crediting period type and duration**

&gt;&gt;

Start date: 01/06/2017

Length of crediting period: 7 years (Renewable)

Crediting period: 01/06/2017-31/05/2024

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

&gt;&gt;

Installation of 0.98MW generator was completed and started commercial operation in 17/10/2016. 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.

To measure accurately, a watt-hour meter was reinstalled by KEPCO in 11/07/2018. 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 shutdowns but there was no significant event affecting the amount of reduction during the monitoring period. In addition, 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. In addition, the monitoring is compliant with the monitoring plan as described in "Operating Manual-Wonju LFG Power Plant related CDM project".

Based on "Operating Manual-Wonju LFG Power Plant related CDM project", if monitoring system error occurs, the flow rate and CH<sub>4</sub> concentration were recorded by hourly work log. In addition, if the result of the zero-span test of gas analyzer is larger than the maximum permissible error (Rel. 5%), the measured CH<sub>4</sub> concentration during the monitoring period should be applied the conservative value. In this monitoring period, there is no adjusted value about the zero-span test.

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

&lt;Table B-1&gt; Operation events history

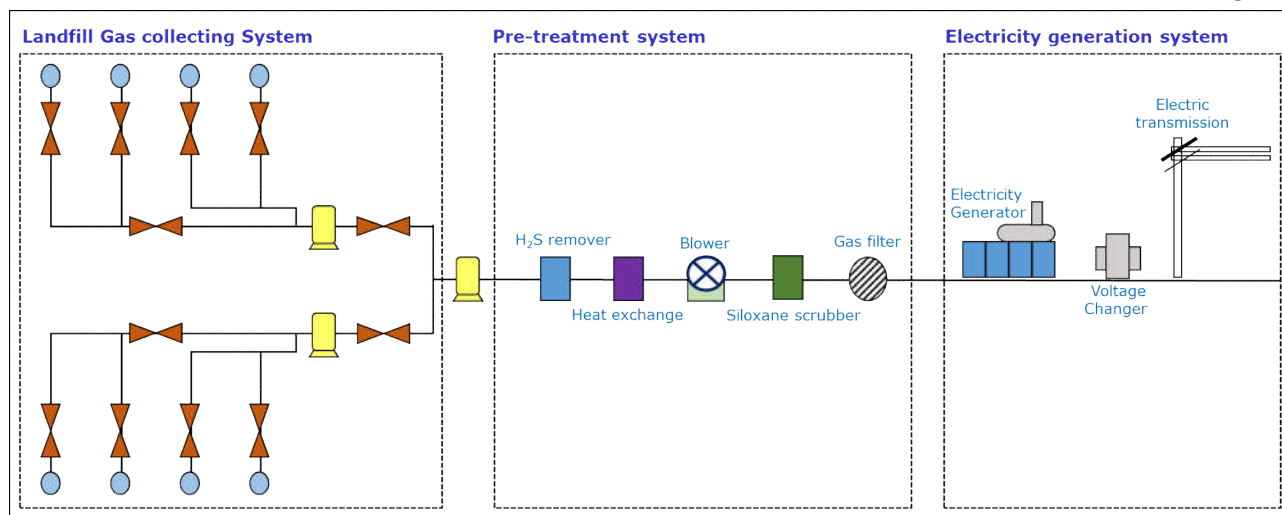
Date	duration		Operation events	Note
17/07/2018	00:00-18:00	18hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
25/07/2018	10:00-23:59	14hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
31/07/2018	17:00-23:59	7hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
05/08/2018	04:00-23:59	20hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
10/08/2018	04:00-23:59	20hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
11/08/2018	00:00-23:59	24hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
12/08/2018	00:00-23:59	24hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
01/09/2018	13:00-23:59	11hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
16/09/2018	07:00-23:59	17hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
22/09/2018	19:00-23:59	6hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
23/09/2018	00:00-23:59	24hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
24/09/2018	00:00-23:59	24hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
06/10/2018	08:00~23:59	16hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
07/10/2018	00:00~23:59	16hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
06/01/2019	00:00-23:59	24hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
22/01/2019	06:00~23:59	18hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction
24/01/2019	01:00-10:00	9hrs	Monitoring system error	The flow rate and CH <sub>4</sub> concentration are not available due to monitoring system error → Keep an hourly work log on the flow rate and CH <sub>4</sub> concentration. Included for estimation of emission reduction

### ***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 this project.

The main features of the LFG facilities are presented below.





<Figure B-6> The main process of the this project

### **Landfill Gas Collecting System**

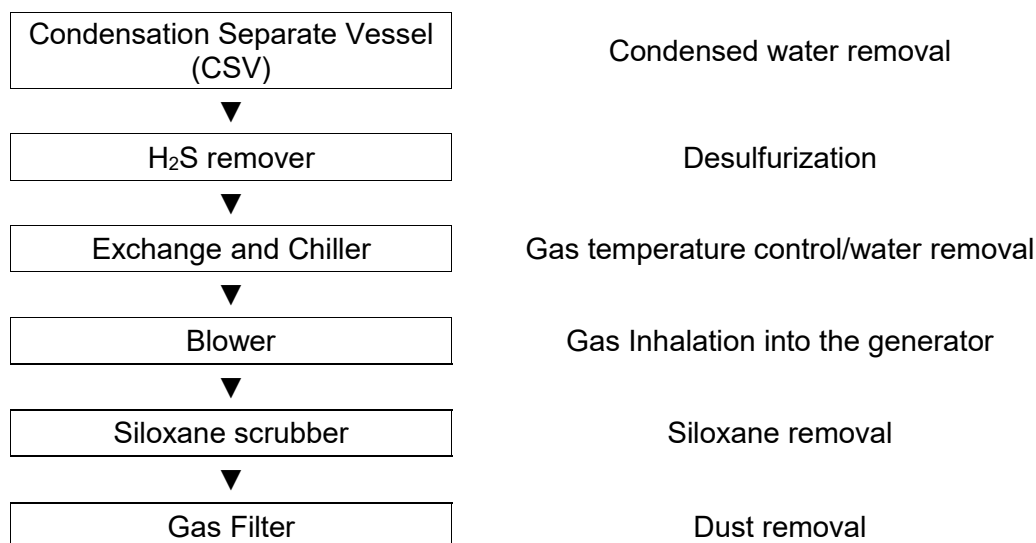
The landfill gas collection system consists of the following elements

- 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;
- Siloxane scrubber to remove siloxane in gas and then the gas deliver it to gas fuelled power generation.

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 was 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. And then after removing sulfur through the desulfurization, removing siloxane in siloxane scrubber and dust in gas filter put it into the generator.



<Figure B-7> The process of pre-treatment system

## Generation System

This project is originally designed to install the four generators with total capacity of 0.98MW (0.245MW×4set) inside the Wonju landfill. But among them 1st, 2nd, 4th generators capacity were downgraded in 0.17MW, 3rd generator was changed to the new one with the capacity of 0.47MW. But, the total capacity of the generators remains unchanged. 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	1st 2nd 4th	Engine manufacture	Doosan Infracore Co., Ltd.
		Model	GV180TI
		Engine Type	V-type 4 cycle, water cooled Turbo charged & intercooled (water to air)
Generation set manufacture		HANATECH	
Model		BDS-170	
Type		Container Type Landfill Gas	
Maximum Electrical Power Output (kW)		170	
Voltage (V)		380	
Frequency (Hz)		60	
Speed (rpm)		1,800	
Engine	3rd	Engine manufacture	Baudouin
		Model	12M26D660E301NG
		Engine Type	Turbocharged & Air-to-Air Aftercooled
Generation set manufacture		HANATECH	
Model		BBS-470	
Type		Container Type Landfill Gas	
Maximum Electrical Power Output (kW)		470	
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

>>

Temporary deviation from registered monitoring plan has applied to 1st monitoring period.

- PRC-10379-001 applied in 1st monitoring: 01/07/2018~16/07/2018
- Reason for deviation: Due to the change in the area of the project activity boundary after this monitoring period.
- Applied temporary deviation: Since the quantity of exported electricity was confirmed by KEPCO every month, the quantity of exported electricity was conservatively recalculated using the highest ratio of the consumption power for the plant.



Temporary deviation from registered monitoring plan has applied to this monitoring period.

- PRC-10379-002 applied in this monitoring: 17/07/2018~31/07/2018

- Reason for deviation: Due to the change in the area of the project activity boundary after 1st monitoring period.

- Applied temporary deviation: The quantity of exported electricity in 17/07/2018~31/07/2018 was recalculated using quantity of exported electricity during 01/07/2018~17/07/2018 in 1<sup>st</sup> monitoring period. The quantity of exported electricity during 17/07/2018~31/07/2018 and 01/07/2018~17/07/2018 is the same "Confirmation of Power Purchase Transaction" issued by a buyer (KEPCO) during July 2018.

#### 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

>>

##### (1) Corrections due to changes to project design

- Corrections described in below are assessed for the post registration change.


	Section	Registered PDD	Revised PDD
1	Purpose and general description of project activity: (A.1.)	The project site of this project was decided as the 1st site according to the business concession agreement with Wonju city. NEWGEN has estimated emission reductions using amounts of LFG collected in 1st site which was landfilled until 2014.	The project site of this project was decided as the 1st and 2nd sites according to the business concession agreement with Wonju city. NEWGEN has estimated emission reductions using amounts of LFG collected in 1st which was landfilled until 2014 and 2nd site which has been landfilled since 2014.
2	Technologies and/or measures: (A.3.)	-	Siloxane scrubber added in - <Figure A-2> - <Figure A-3> - Landfill Collection System
3	Technologies and/or measures: (A.3.)	-	generator information changed in - <Table A-1>


4	Applicability of methodologies and standardized baselines: (B.2)	This project will capture LFG generated from 1st site in Wonju landfill, which was used for the disposal of residues from human activities.	This project will capture LFG generated from 1st and 2nd sites in Wonju landfill, which were used for the disposal of residues from human activities.
5	B.2. Applicability of methodologies and standardized baselines: (B.2)	Also the condition is not applicable since there was no waste landfill at the 1st site after 2014.	deleted
6	Applicability of methodologies and standardized baselines: (B.2)	[AMS-III.G] There was no waste landfill at the 1st site after 2014. Therefore, there is no possibility to change the management of SWDS deliberately changed in order to increase methane generation compared to the situation prior to the implementation of the project activity. Therefore, this applicability condition is not relevant to this project.	<b>Changed</b> - Waste to be filled in the landfill is covered up with soil after moved immediately to the landfill. Therefore, there is no additional process to increase methane production.
7	Demonstration of additionality: (B.5.)	<Table B-4> Detailed activity of notification -Pre-inspection check of generation equipment - 03/11/2016 - Start date of operation - 16/12/2016	<b>Added</b> "Began commercial operation 17/10/2016" <b>Changed</b> - Completed pre-operational inspection (commercial operation and selling electricity) - 03/11/2016 - Reported of opening a business - 16/12/2016
8	Environmental impact assessment	-	Added "Not applicable, as no environmental impact assessment is required."

***The changes of plant generator are as below;***

The four generators installed with a total capacity of 0.98MW (0.245MWx4set). 2 or 3 of the four generators are operated alternately depending on the amount of the gas, the CH<sub>4</sub> concentration, the condition of the generator, and the seasonal conditions. Among them 1st, 2nd, 4th generators capacity were downgraded in 0.17MW, 3rd generator was changed to the new one with the capacity of 0.47MW. But, the total capacity of the generators remains unchanged. In accordance with "CLEAN AIR CONSERVATION ACT", project participant got the "Permission to install air discharge facility (notification)" from the government.

\*참정한 원주! 미래가 아니라 지금입니다.\*



**원 주 시**  


수신 (주)뉴젠일렉트릭 대표이사 귀하  
(경유)  
제목 대기배출시설 변경신고 수리통보[(주)뉴젠일렉트릭]

1. 귀 사에서 제출하신 대기배출시설 변경신고 신청 건에 대하여 「대기환경보전법」 제23조제3항 및 같은 법 시행규칙 제27조 규정에 의거 다음과 같이 수리되었음을 통보하오니, 관련 규정에 따라 시설 운영에 철저를 기하여 주시기 바랍니다.


2. 아울러, 사업장에서 배출되는 대기오염물질 관리에 철저를 기하여 대기오염과 악취 발생으로 인한 인근 주민의 피해가 없도록 노력하여 주시기 바랍니다.

☐ 변경사항

신고 번호	상호	대표자 (법인번호)	소재지	구분	변경 전	변경 후	비고
547	뉴젠일렉트릭	대표이사 (280211-0137816)	원주시 흥업면 수루나길 116	배출시설 용량 변경	254kW×4기	170kW×3기 470kW×1기	4층 (중변경업종)

■ 대기환경보전법 열람 : 환경부(<http://www.me.go.kr>) 또는 국가법령정보센터(<http://www.law.go.kr>)  
■ 대기환경기술인 교육 : 환경보전협회(<http://www.epa.or.kr>) 및 강원협회(033-251-2676)

붙임 1. 대기배출시설설치 신고증명서 1부.  
2. 배출시설설치사업자의 준수사항 1부.  
3. 대기배출시설 및 방지시설 운영기록부 1부.  
4. 자가측정의 대상항목 및 방법 1부. 끝.

**원 주 시**  


주무관 최종길 대기관리담당 전홍열 기후정책담당 김주현 상  
참조자  
시행 기후에너지과-38744 (2018. 10. 23.) 협수  
부 26384 강원도 원주시 시청로 1, 기후에너지과(무상통, 원주시청) / <http://www.wonju.go.kr>  
전화번호 033-737-3042 팩스번호 033-737-4969 / cij76@korea.kr / 비공개(5,7)

**< acceptance of change of the air emission facility >**

## The Official Document

Addressee : Wonju landfill Community  
Residential Support chairperson

Transmit : Wonju Environmental Affairs Agency

Title : Notification of acceptance of change of the air emission facility.

## Main content :

According to 'CLEAN AIR CONSERVATION ACT', accepted the change of the generator capacity.

## ○ Changes

- (before) <generator facility>  
245kW x 4
- (after) <generator facility>  
170kW x 3, 470kW x 1

■ 대기환경보전법 시행규칙 [별지 제3호서식] <대공 2013.5.24> (단독)

허가(신고)번호: 제547호

**대기배출시설설치 ( [ ] 허가증, [√] 신고증명서 )**

상 호	(주) 뉴젠일렉트릭	종 별	4층
상 (사업장명칭)	(원주시 매립장 매립가스 발전소)	종 별	4층
성 (대표자)	대표이사	사 업 자 번 호	224-83-04702 (280211-0137816)
사업장소재지	강원도 원주시 흥업면 수루나길 116	전 화 번 호	010-3124-6630
업 종	폐기물처리시설부대시설 (매립가스처리시설)	일 일 조 업 시 간	24시간/일 (300일/년)
연 료 사 용 량	『 별첨 』		
오염물질 등을 배출하는 시설물 및 방지시설	생성공정 배출시설 연료 및 원료사용량 용량 수량 방지시설명 용량 수량		
오염물질 발생량	『 별첨 』		
허가(신고)사항	오염물질 종류 (먼지, SO <sub>2</sub> , NO <sub>x</sub> ) 연료 및 원료 사용량 배출계수 발생량		
	계	-	4.846ton/년
	먼지	매탄 38 m <sup>3</sup> /hr 0.03 kg/10 <sup>3</sup> m <sup>3</sup>	0.038ton/년
	황산화물	매탄 38 m <sup>3</sup> /hr 0.01 kg/10 <sup>3</sup> m <sup>3</sup>	0.013ton/년
	질소산화물	매탄 38 m <sup>3</sup> /hr 3.70 kg/10 <sup>3</sup> m <sup>3</sup>	4.795ton/년
	허가조건		
	대기환경보전법 관계 규정을 준수할 것		
「대기환경보전법」 제23조제1항 및 같은 법 시행규칙 제25조에 따라 배출시설의 [ ] 설치를 허가, [√] 설치신고를 증명) 합니다.			
2016년 11월 16일			

<Permission to install air discharge facility  
(notification)>

(단독)

<변경 사항>

일 자	내 용	확 인 (서명 또는 인)
2016.11.16.	신규설치신고[(주)뉴젠일렉트릭]	업 선 호
2016.12.07.	대기 배출시설 변경신고[발전기 용량 변경, 변경 전: 167kW×4대 변경 후: 254kW×4대(1대 예비용 포함)로 변경]	업 선 호
2018.10.22.	배출시설(발전시설) 용량 변경 신고 수리 [변경 전: 254kW×4대, 변경 후: 170kW×3대, 470kW×1대] [오염물질 발생량: 4.845톤/년에서 4.846톤/년으로 변경] ※ 종 변경 없음(4층), 기재사항 변경에 따른 갱신 교부	최 종 결심

2018.10.22 Acceptation of change of emission facility (generation facility)  
[Before: 245kWx4, after: 170kWx3, 470kWx1]  
[Amount of pollutants: changed from 4.845t/y to 4.846t/y]  
※ No change in generator number,  
revised due to updating capacity of the generator

<처분 사항>

일 자	내 용	확 인 (서명 또는 인)

<참고 사항>

일 자	내 용	확 인 (서명 또는 인)
2016.11.25.	가동개시 신고수리	업 선 호

**<Changes>**

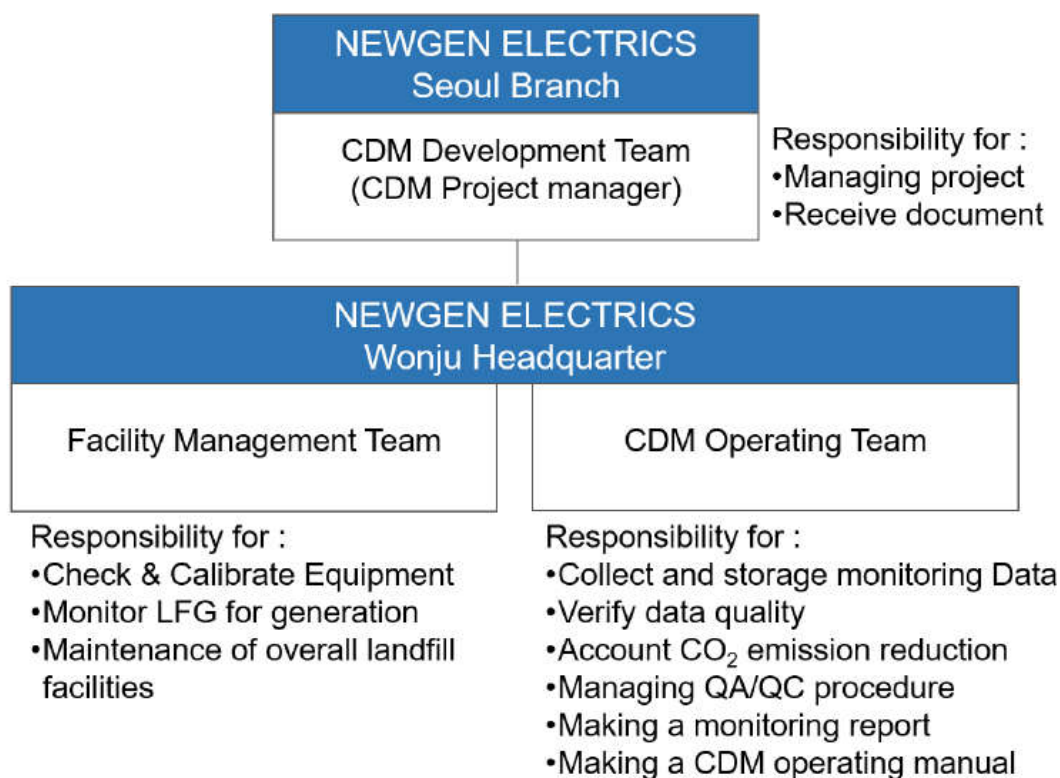
## SECTION C. Description of monitoring system

&gt;&gt;

Monitoring data and parameters are monitored and their measurement method is referred to "Operating Manual-Wonju LFG Power Plant related CDM project". 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. The following table shows the responsible party for each task of monitoring.



<Figure C-1> The structure of monitoring system

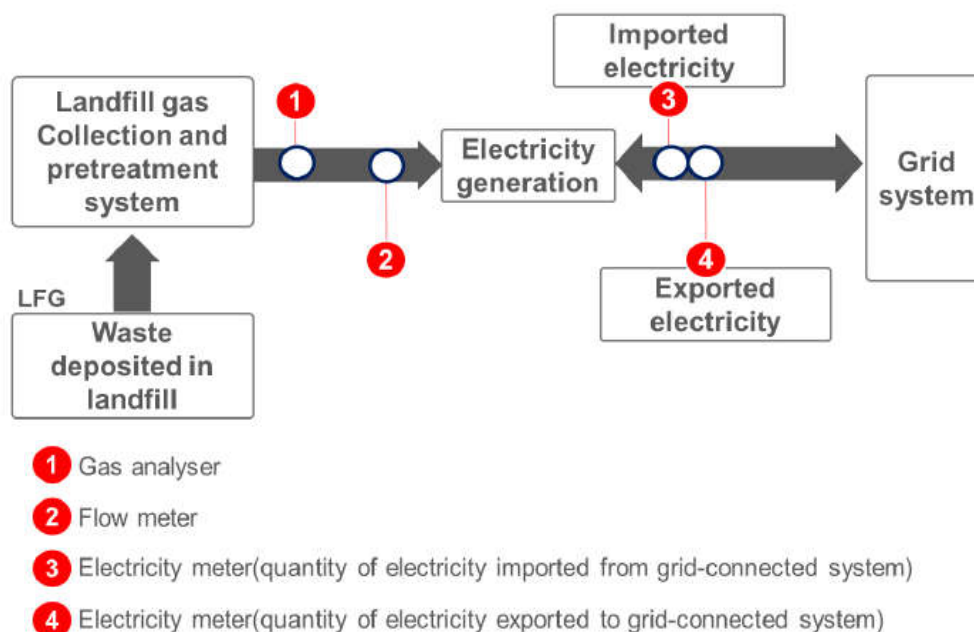
<Table C-1> The responsible party for each task of monitoring

Item	Sub-item	Responsible person
Measure & Archive	EGPJ,facility,y	CDM Operating Team
	LFGi,y	
	WCH4,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<sub>4</sub> analyzer is located before the above flow meter to measure the fraction of methane in LFG volume fed into the gas engine. That was 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 exported electricity (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<sub>4</sub> 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 meters measuring electricity exported to the grid and imported from the grid was 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 at least two years after the end of the final crediting period or the last issuance of CERs, whichever occurs later. 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 were 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<sub>4</sub> 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 meters measuring electricity exported to the grid and imported from grid will be 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 (CDM Operating Team). Operation review, internal audit and corrective action are carried out by CDM Operating Team according to the “Operating Manual-Wonju LFG Power Plant related CDM project”.

***Emergency procedure***

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

***Training***

Employees involved in the monitoring took the training on the overall CDM project activity. Trainings for emissions trading scheme, the monitoring and operation was done by experts (from consulting company) and LFG CDM project manager of headquarter on 28/11/2018.

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

&gt;&gt;

Data / Parameter	D <sub>CH<sub>4</sub></sub>
Unit	tCH <sub>4</sub> /m <sup>3</sup> CH <sub>4</sub>
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 <sup>3</sup>
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	GWP <sub>CH<sub>4</sub></sub>
Unit	tCO <sub>2</sub> e/t
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 <sub>2</sub> . The oxidation factor represents the proportion of methane that is oxidized to CO <sub>2</sub> . 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 <sub>m,y</sub>
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 <sub>m,y</sub> 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 <sub>i,m,y</sub>
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 <sub>i,m,y</sub> 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 <sub>i,y</sub>								
Unit	GJ/mass or volume unit								
Description	Net calorific value (energy content) of fuel type i in year y								
Source of data	<p>The following data sources may be used if the relevant conditions apply:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g. utilities)</td></tr> <tr> <td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics/energy balances</td></tr> <tr> <td>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</td><td></td></tr> </tbody> </table> <p>As per "2013~2015 Statistics of Electric Power in Korea" provided by KEPCO, NCV<sub>i,y</sub> values provided by the national energy statistics</p>	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	
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									
Value(s) applied	values provided by the national energy statistics								
Choice of data or Measurement methods and procedures	NCV <sub>i,y</sub> 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 <sub>CO<sub>2</sub>,i,y</sub>								
Unit	tCO <sub>2</sub> /GJ								
Description	CO <sub>2</sub> emission factor of fuel type i used in power unit m in year y								
Source of data	<p>“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:</p> <table border="1"> <thead> <tr> <th>Data source</th><th>Conditions for using the data source</th></tr> </thead> <tbody> <tr> <td>Values provided by the fuel supplier of the power plants in invoices</td><td>If data is collected from power plant operators (e.g.utilities)</td></tr> <tr> <td>Regional or national average default values</td><td>If values are reliable and documented in regional or national energy statistics/energy balances</td></tr> <tr> <td>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</td><td></td></tr> </tbody> </table> <p>Emission factor by fuel in “Guideline for the greenhouse gas target management system(2016.12.30)”, EF<sub>CO<sub>2</sub>,i,y</sub> values provided by the national average default values</p>	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	
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									
Value(s) applied	National average default values								
Choice of data or Measurement methods and procedures	EF <sub>CO<sub>2</sub>,m,i,y</sub> 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 <sub>OM,y</sub>
Unit	tCO <sub>2</sub> /MWh
Description	Operating margin CO <sub>2</sub> 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 <sub>OM</sub> 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 <sub>OM</sub> 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 <sub>BM,y</sub>
Unit	tCO <sub>2</sub> /MWh
Description	Build margin CO <sub>2</sub> 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 <sub>BM</sub> 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 <sub>BM</sub> is fixed for the crediting period.
Purpose of data	Estimated as baseline emissions
Additional comment	-

Data / Parameter	EF <sub>grid,y</sub>
Unit	tCO <sub>2</sub> /MWh
Description	CO <sub>2</sub> 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 <sub>grid,y</sub> ) is calculated as the weighted average of the simple OM emission factor (EF <sub>grid,OM,y</sub> ) and the BM emission factor (EF <sub>grid,BM,y</sub> ). By default, both margins have equal weights (50%)
Purpose of data	Estimated as baseline emissions
Additional comment	-

## D.2. Data and parameters monitored

&gt;&gt;

Data/Parameter	$W_{CH_4,y}$	
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	Measured $CH_4$ (%) (Weighted average $CH_4$ concentration)
	17/07/2018-30/04/2019	41.875
Monitoring equipment	Tag	$W_{CH_4,y}$
	Serial No	34001096
	Accuracy level	Rel. 5%
	Type	stationary gas analyzer
	Calibration frequency	3 years
	Date of last calibration	09/09/2016
	Validity	08/09/2019
Measuring/reading/recording frequency	Measuring frequency: continuously Recording frequency: hourly	
Calculation method (if applicable)	Weighted average $CH_4$ concentration	
QA/QC procedures	Gas analyzer was subject to maintenance and calibration according to manufacturer recommendations. Zero-span test was accomplished by means of reference gas (mixture calibration gas) bottles, which was 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	Date	$LFG_{i,y}$
	17/07/2018-31/07-2018	88,823.000
	01/08/2018-31/08/2018	228,641.000
	01/09/2018-30/09/2018	255,652.000
	01/10/2018-31/10/2018	264,773.000
	01/11/2018-30/11/2018	268,684.000
	01/12/2018-31/12/2018	246,758.000
	01/01/2019-31/01/2019	302,964.000
	01/02/2019-28/02/2019	268,896.000
	01/03/2019-31/03/2019	280,466.000
	01/04/2019-30/04/2019	300,125.000
	17/07/2018~30/04/2019	2,505,782.000

Monitoring equipment	<b>Tag</b>	<b>LFG<sub>i,y</sub></b>
	Serial No	K-1609083
	Accuracy level	±0.5% of F.S
	Type	Gas Flow Meter
	Calibration frequency	3 years
	Date of last calibration	20/09/2016
	Validity	19/09/2019
	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	-	

<b>Data/Parameter</b>	EG <sub>PJ,facility,y</sub>																								
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	<p>(a) the quantity of electricity exported by the project plant/unit to the grid</p> <table> <tr> <th>Date</th><th>Measured EG<sub>PJ,facility,y</sub> (MWh)</th></tr> <tr><td>17/07/2018-31/07-2018</td><td>97.899</td></tr> <tr><td>01/08/2018-31/08/2018</td><td>207.720</td></tr> <tr><td>01/09/2018-30/09/2018</td><td>258.473</td></tr> <tr><td>01/10/2018-31/10/2018</td><td>274.889</td></tr> <tr><td>01/11/2018-30/11/2018</td><td>249.559</td></tr> <tr><td>01/12/2018-31/12/2018</td><td>252.749</td></tr> <tr><td>01/01/2019-31/01/2019</td><td>238.082</td></tr> <tr><td>01/02/2019-28/02/2019</td><td>268.896</td></tr> <tr><td>01/03/2019-31/03/2019</td><td>233.993</td></tr> <tr><td>01/04/2019-30/04/2019</td><td>116.996</td></tr> <tr><td><b>17/07/2018~30/04/2019</b></td><td><b>2,199.256</b></td></tr> </table> <p>- The quantity of exported electricity (a) in 01/07/2018-31/07/2018 was confirmed to be 207.360MWh from KEPCO. However, due to change in the area of the project activity boundary in this monitoring period, the quantity of exported electricity in 17/07/2018-31/07/2018 was calculated using the value excluding the amount of 1<sup>st</sup> monitoring period(109.461MWh).</p>	Date	Measured EG <sub>PJ,facility,y</sub> (MWh)	17/07/2018-31/07-2018	97.899	01/08/2018-31/08/2018	207.720	01/09/2018-30/09/2018	258.473	01/10/2018-31/10/2018	274.889	01/11/2018-30/11/2018	249.559	01/12/2018-31/12/2018	252.749	01/01/2019-31/01/2019	238.082	01/02/2019-28/02/2019	268.896	01/03/2019-31/03/2019	233.993	01/04/2019-30/04/2019	116.996	<b>17/07/2018~30/04/2019</b>	<b>2,199.256</b>
Date	Measured EG <sub>PJ,facility,y</sub> (MWh)																								
17/07/2018-31/07-2018	97.899																								
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<b>17/07/2018~30/04/2019</b>	<b>2,199.256</b>																								

	<p>(b) the quantity of electricity imported to the project plant/unit from the grid</p> <table border="1"> <thead> <tr> <th>Date</th><th>Measured EG<sub>PJ, facility, y</sub> (MWh)</th></tr> </thead> <tbody> <tr><td>15/07/2018-14/08/2018</td><td>0.202</td></tr> <tr><td>15/08/2018-14/09/2018</td><td>0.367</td></tr> <tr><td>15/09/2018-14/10/2018</td><td>0.057</td></tr> <tr><td>15/10/2018-14/11/2018</td><td>0.066</td></tr> <tr><td>15/11/2018-14/12/2018</td><td>0.367</td></tr> <tr><td>15/12/2018-14/01/2019</td><td>0.238</td></tr> <tr><td>15/01/2019-14/02/2019</td><td>0.201</td></tr> <tr><td>15/02/2019-14/03/2019</td><td>0.014</td></tr> <tr><td>15/03/2019-14/04/2019</td><td>0.014</td></tr> <tr><td>15/04/2019-30/04/2019</td><td>0.014</td></tr> <tr><td><b>17/07/2018~30/04/2019</b></td><td><b>1.540</b></td></tr> </tbody> </table> <p>- The quantity of imported electricity (b) in 15/04/2019-30/04/2019 was confirmed to be 0.014MWh from KEPCO. Even if there is the change in the area of the project activity boundary after this monitoring period, the entire quantity of electricity imported of the month was included in this monitoring period (15/04/2019-30/04/2019).</p>	Date	Measured EG <sub>PJ, facility, y</sub> (MWh)	15/07/2018-14/08/2018	0.202	15/08/2018-14/09/2018	0.367	15/09/2018-14/10/2018	0.057	15/10/2018-14/11/2018	0.066	15/11/2018-14/12/2018	0.367	15/12/2018-14/01/2019	0.238	15/01/2019-14/02/2019	0.201	15/02/2019-14/03/2019	0.014	15/03/2019-14/04/2019	0.014	15/04/2019-30/04/2019	0.014	<b>17/07/2018~30/04/2019</b>	<b>1.540</b>							
Date	Measured EG <sub>PJ, facility, y</sub> (MWh)																															
15/07/2018-14/08/2018	0.202																															
15/08/2018-14/09/2018	0.367																															
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15/12/2018-14/01/2019	0.238																															
15/01/2019-14/02/2019	0.201																															
15/02/2019-14/03/2019	0.014																															
15/03/2019-14/04/2019	0.014																															
15/04/2019-30/04/2019	0.014																															
<b>17/07/2018~30/04/2019</b>	<b>1.540</b>																															
Monitoring equipment	<table border="1"> <thead> <tr> <th rowspan="2">Tag</th><th colspan="3">EG<sub>PJ, facility, y</sub></th></tr> <tr> <th>Electricity meter (exported)</th><th>*Electricity meter (imported)</th><th>**Electricity meter (imported)</th></tr> </thead> <tbody> <tr><td>Serial No</td><td>08162027757</td><td>05131020188</td><td>24176002263</td></tr> <tr><td>Accuracy level</td><td>±0.5s</td><td>±1s</td><td>±0.5</td></tr> <tr><td>Type</td><td>Watt-hour meter</td><td>Watt-hour meter</td><td>Watt-hour meter</td></tr> <tr><td>Calibration frequency</td><td>7 years</td><td>7 years</td><td>7 years</td></tr> <tr><td>Date of last calibration</td><td>04/07/2016</td><td>01/07/2013</td><td>22/12/2017</td></tr> <tr><td>Validity</td><td>03/07/2023</td><td>30/06/2020</td><td>21/12/2024</td></tr> </tbody> </table> <p>- To measure accurately, reinstalled the *electricity meter (SN: 05131020188) to new **electricity meter (SN: 24176002263) in 11/07/2018 by KEPCO.</p> <p>- To ensure accuracy, electricity meter (SN: 24176002263) are subject to regular maintenance by KEPCO.</p>	Tag	EG <sub>PJ, facility, y</sub>			Electricity meter (exported)	*Electricity meter (imported)	**Electricity meter (imported)	Serial No	08162027757	05131020188	24176002263	Accuracy level	±0.5s	±1s	±0.5	Type	Watt-hour meter	Watt-hour meter	Watt-hour meter	Calibration frequency	7 years	7 years	7 years	Date of last calibration	04/07/2016	01/07/2013	22/12/2017	Validity	03/07/2023	30/06/2020	21/12/2024
Tag	EG <sub>PJ, facility, y</sub>																															
	Electricity meter (exported)	*Electricity meter (imported)	**Electricity meter (imported)																													
Serial No	08162027757	05131020188	24176002263																													
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Type	Watt-hour meter	Watt-hour meter	Watt-hour meter																													
Calibration frequency	7 years	7 years	7 years																													
Date of last calibration	04/07/2016	01/07/2013	22/12/2017																													
Validity	03/07/2023	30/06/2020	21/12/2024																													
Measuring/reading/recording frequency	<p>Measuring frequency: Continuously</p> <p>Recording frequency: Monthly</p>																															
Calculation method (if applicable)	<p>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.</p>																															
QA/QC procedures	<p>Electricity meters are subject to a regular maintenance and testing to ensure accuracy.</p> <p>Electricity meter for (a) is calibrated every 7 years in accordance with "ENFORCEMENT DECREE OF MEASURES ACT".</p> <p>Electricity meter for (b) is calibrated every 7 years in accordance with "ENFORCEMENT DECREE OF MEASURES ACT".</p> <p>The value is cross-checked with the invoice from KEPCO.</p>																															
Purpose of data/parameter	<p>Calculation of baseline emissions (ex post)</p>																															
Additional comments	-																															

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

&gt;&gt;

N/A

**SECTION E. Calculation of emission reductions or net anthropogenic removals****E.1. Calculation of baseline emissions or baseline net removals**

&gt;&gt;

$$BE_y = BE_{CH_4,y} + BE_{electricity,y}$$

Parameter	Unit	Description
$BE_y$	tCO <sub>2</sub> e	Baseline emission for in year y
$BE_{CH_4,y}$	tCO <sub>2</sub> e	Baseline emission from LFG avoidance that otherwise would be emitted to the atmosphere in absence of the Project in year y (tCO <sub>2</sub> e) which is estimated as per AMS-III.G
$BE_{electricity,y}$	tCO <sub>2</sub> e	Baseline emission from electricity displacement that otherwise would be provided by grid in year y (tCO <sub>2</sub> e) which is estimated as per AMS-I.D

**Baseline emission from LFG avoidance ( $BE_{CH_4,y}$ )**

Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirements or legal regulations and is based on the amount of methane that is actually captured and combusted (destroyed) by the project activity.

$$BE_{CH_4,y} = \eta_{PJ} \times BE_{CH_4,SWDS,y} - (1-OX) \times F_{CH_4,BL,y} \times GWP_{CH_4}$$

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

Baseline emissions include only CO<sub>2</sub> emissions from electricity generation in power plants that are displaced due to the project activity.

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

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

&gt;&gt;

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

Parameter	Unit	Description
$PE_y$	tCO <sub>2</sub> e	Project emissions in year y
$PE_{power,y}$	tCO <sub>2</sub> e	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y
$PE_{flare,y}$	tCO <sub>2</sub> e	Emissions from flaring or combustion of the landfill gas stream in the year y
$PE_{process,y}$	tCO <sub>2</sub> e	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

$EF_{grid,y}$  is 0.6523 tCO<sub>2</sub>/MWh and this is fixed factor during the crediting period.

$$PE_y = PE_{power,y}$$

Project emissions consist of CO<sub>2</sub> emissions related to the power used by this project facility.



**E.3. Calculation of leakage emissions**

&gt;&gt;

There is no leakage effect in this project.

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

&gt;&gt;

	Baseline GHG emissions or baseline net GHG removals (tCO <sub>2</sub> e)	Project GHG emissions or actual net GHG removals (tCO <sub>2</sub> e)	Leakage GHG emissions (tCO <sub>2</sub> e)	GHG emission reductions or net anthropogenic GHG removals (tCO <sub>2</sub> e)		
				Before 01/01/2013	From 01/01/2013	Total amount
<b>Total</b>	15,085.315	0	0	0	15,085.315	15,085

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

$$ER_{y,calculated} = (1 - OX) \times (F_{CH_4,PJ,y} - F_{CH_4,BL,y}) \times GWP_{CH_4} + (EG_{PJ,facility,y} \times EF_{grid,y}) - LE_y$$

Parameter	Unit	Description
ER <sub>y,calculated</sub>	tCO <sub>2</sub> e	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 <sub>CH<sub>4</sub>,PJ,y</sub>	tCH <sub>4</sub>	Methane captured and destroyed/gainfully used by the project activity in the year
F <sub>CH<sub>4</sub>,BL,y</sub>	tCH <sub>4</sub>	Methane emissions that would be captured and destroyed to comply with national or local safety requirement or legal regulations in the year (tCH <sub>4</sub> ). 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 <sub>CH<sub>4</sub></sub>	-	Global Warming Potential for methane (value of 25)
EG <sub>PJ,facility,y</sub>	MWh	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
EF <sub>grid,y</sub>	tCO <sub>2</sub> /MWh	CO <sub>2</sub> emission factor of the grid electricity in year y
LE <sub>y</sub>	tCO <sub>2</sub> e	Leakage emissions from both methane destruction and grid displacement

The values for this monitoring period are:

Period	OX	F <sub>CH4,PJ,y</sub>	F <sub>CH4,BL,y</sub>	GWP <sub>CH4</sub>	EG <sub>PJ,facility,y</sub>	EF <sub>grid,y</sub>	LE <sub>y</sub>	ER <sub>y,calculated</sub>
	-	tCH <sub>4</sub>	tCH <sub>4</sub>	-	MWh	tCO <sub>2</sub> /MWh	tCO <sub>2e</sub>	tCO <sub>2e</sub>
17/07/2018-30/04/2019	0.100	758.430	151.686	25	2,197.716	0.6523	0	15,085.315

Determination of F<sub>CH4,PJ,y</sub>:

Methane captured and destroyed/gainfully used by the project activity (F<sub>CH4,PJ,y</sub>) 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 <sub>CH4,PJ,y</sub>	tCH <sub>4</sub>	Methane captured and destroyed/gainfully used by the project activity in the year
D <sub>CH4,y</sub>	tonnes/m <sup>3</sup>	Density of methane at the temperature and pressure of the landfill gas in year. If LFG <sub>i,y</sub> is reported at normal conditions of temperature and pressure, the density of methane is also determined at normal conditions
W <sub>CH4,y</sub>	m <sup>3</sup> CH <sub>4</sub> /m <sup>3</sup> LFG	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 <sub>i,y</sub>
LFG <sub>i,y</sub>	m <sup>3</sup> LFG	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 <sub>CH4,y</sub>

The values for this monitoring period are:

Period	F <sub>CH4,PJ,y</sub>	D <sub>CH4,y</sub>	W <sub>CH4,y</sub>	LFG <sub>i,y</sub>
	(tCH <sub>4</sub> )	(tonnes/m <sup>3</sup> )	(m <sup>3</sup> CH <sub>4</sub> /m <sup>3</sup> LFG)	(m <sup>3</sup> LFG)
17/07/2018-30/04/2019	758.430	0.0007168	41.875	2,526,752.000

Determination of F<sub>CH4,BL,y</sub>:

F<sub>CH4,BL,y</sub> was determined in accordance with case 4 of “ACM0001: Flaring or use of landfill gas” and PDD as below.

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

The values for this monitoring period are:

Period	F <sub>CH4,PJ,y</sub>	F <sub>CH4,BL,y</sub>
	(tCH <sub>4</sub> )	(tCH <sub>4</sub> )
17/07/2018-30/04/2019	758.430	151.686

The actual  $EG_{PJ, facility, y}$  monitoring values are shown as follows;

Period	$EG_{PJ, facility, y}$ (a)	$EG_{PJ, facility, y}$ (b)	$EG_{PJ, facility, y}$ (MWh)	$EF_{grid, y}$ (tCO <sub>2</sub> /MWh)
	(MWh)	(MWh)		
17/07/2018-30/04/2019	2,199.256	1.540	2,197.716	0.6523

$EG_{PJ, facility, y}$  is either monitored using each electricity meter and calculated as the 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.

The quantity of exported electricity in 17/07/2018-30/04/2019 was calculated using the value excluding the amount of 1st monitoring period (109.461MWh).

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

Amount achieved during this monitoring period (tCO <sub>2e</sub> )	Amount estimated ex ante (tCO <sub>2e</sub> )
15,085	11,526

#### E.6. Remarks on increase in achieved emission reductions

>>

**Actual values reached during the monitoring period: 15,085 tCO<sub>2e</sub>**

**Values applied in ex-ante calculation of the registered CDM-PDD: 11,526 tCO<sub>2e</sub>**

The emission reductions increased to 30.87% 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.

#### **The difference with estimated LFG flow**

The expected LFG by waste composition analysis can be differs from actual LFG generation on monitoring system as below.

Source \ year		2017	2018	Total
Amounts of the LFG captured through LFG capture system (m <sup>3</sup> /min)	PDD(ER)	1.571	1.019	2.590
	MR	-		6.093

The LFG flow was estimated to be 2.590 m<sup>3</sup>/min (on the registered CDM-PDD: 168days in 2018, 120days in 2019) but the actual average flow was 6.093m<sup>3</sup>/min during the monitoring period. In other words, there was 235% of the difference between the theoretical and the actual values.

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

<b>Project participant and/or responsible person/ entity</b>	<input checked="" type="checkbox"/> Project participant <input checked="" type="checkbox"/> Person/entity responsible for completing the CDM-MR-FORM
<b>Organization name</b>	NEWGEN ELECTRICS Co., Ltd.
<b>Street/P.O. Box</b>	San, 185, Saje-ri, Heungeop-myeon
<b>Building</b>	-
<b>City</b>	Wonju
<b>State/region</b>	Gangwon-province
<b>Postcode</b>	26356
<b>Country</b>	Republic of Korea
<b>Telephone</b>	82-(0)70-5099-0296
<b>Fax</b>	82-(0)70-5099-0297
<b>E-mail</b>	medaglia@newgen-el.com
<b>Website</b>	-
<b>Contact person</b>	Moon Gu, Lee
<b>Title</b>	Rep. Director
<b>Salutation</b>	Mr.
<b>Last name</b>	Lee
<b>Middle name</b>	-
<b>First name</b>	Moon Gu
<b>Department</b>	CDM project manager
<b>Mobile</b>	-
<b>Direct fax</b>	82-(0)70-5099-0297
<b>Direct tel.</b>	82-(0)70-5099-0296
<b>Personal e-mail</b>	medaglia@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 2nd)Wonju LFG to Energy Project\_ver.1.0\_190502

## Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
06.0	7 June 2017	Revision to: <ul style="list-style-type: none"> <li>• Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);</li> <li>• Make editorial improvements.</li> </ul>
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: <ul style="list-style-type: none"> <li>• Include provisions related to delayed submission of a monitoring plan;</li> <li>• Provisions related to the Host Party;</li> <li>• Remove reference to programme of activities;</li> <li>• Overall editorial improvement.</li> </ul>
04.0	25 June 2014	Revisions to: <ul style="list-style-type: none"> <li>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));</li> <li>• Include provisions related to standardized baselines;</li> <li>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;</li> <li>• Change the reference number from <i>F-CDM-MR</i> to <i>CDM-MR-FORM</i>;</li> <li>• Editorial improvement.</li> </ul>
03.2	5 November 2013	Editorial revision to correct table in page 1.
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 GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, 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).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: monitoring report		