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# VERIFICATION AND CERTIFICATION REPORT

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## MOKPO LANDFILL GAS RECOVERY PROJECT FOR ELECTRICITY GENERATION

REPORT No. 2013-10



VERSION NO. 01.1

**KOREAN FOUNDATION FOR QUALITY**



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Approver Name : Yu Shim Jeong Date: 6 December 2013		Organisational unit: Korean Foundation for Quality (KFQ)	
Client:  Hanwha Corporation		Client ref.:  Mr. Jae Hong PARK	
Summary:  Korean Foundation for Quality (KFQ) has performed the fourth periodic verification of the CDM project "Mokpo Landfill Gas Recovery Project for Electricity Generation", UNFCCC Registration Ref. No. 2834 for the period 19 August 2012 ~ 18 August 2013. The main objective of the project activity is to collect and utilize LFG for generating electricity owned by Hanwa Corporation which is located in Mokpo city of Republic of Korea.  The verification consisted of document review, followed by a site visit conducted on 20 August 2013, issuance of CAR/CL report addressing outstanding issue, follow up audit and issuance of the final verification report and opinion. Based on the assessment carried out, KFQ confirms the following: <ul style="list-style-type: none"> <li>the project has been implemented and operated in accordance with the description given in the revised PDD (version 05, dated 29/11/2013)</li> <li>the monitoring plan complies with the applied methodology (<i>AMS-I.D Version 13, AMS-III.G Version 6</i>)</li> <li>the monitoring has been carried out as per the monitoring plan in the revised PDD (version 05, dated 29/11/2013)</li> <li>installed equipment essential for generating emission reductions runs reliably and the meters are calibrated appropriately. The project is generating emission reductions as a CDM project.</li> </ul> KFQ also confirms that the GHG emission reductions are calculated without material misstatements. Our opinion refers to the project's GHG emissions and resulting GHG emission reductions reported, both determined using the valid and registered project's baseline, its monitoring plan and its associated documents.  The implementation of the project resulted in 41,686 tCO <sub>2</sub> e of emission reductions during the monitoring period 19 August 2012 ~ 18 August 2013 which is within the fixed crediting period from 18 February 2010 to 17 February 2020.			

Work carried out by :  Eun Jung KIM (Audit team leader, GHG auditor) Jin Seok CHO (Auditor team member, GHG auditor)	Internal technical review carried out by :  Sung Han YOON
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**Abbreviations**

AMS	Approved Small Scale Methodology
CARs	Corrective Action Requests
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CERs	Certified Emission Reductions
CLs	Clarification requests
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	Carbon dioxide Equivalent
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
KEPCO	Korea Electric Power Corporation
KFQ	Korean Foundation for Quality
KPX	Korea Power Exchange
LFG	Landfill Gas
MoV	Means of verification
MP	Monitoring Plan
PDD	Project Design Document
PP	Project Participant
SWDS	Solid Waste Disposal Site
UNFCCC	United Nations Framework Convention for Climate Change
VVS	Validation and Verification Standard

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## 1 INTRODUCTION

Korean Foundation for Quality (KFQ) has been engaged by Hanwha Corporation to perform an independent verification of registered CDM project “Mokpo Landfill Gas Project for Electricity Generation (UNFCCC Registration Ref. No. 2834)” for the period 19/08/2012~18/08/2013.

This verification report summarizes the processes and findings in the verification of the Project, performed on the basis of CDM criteria and relevant guidance provided by the CMP and the CDM Executive Board.

### 1.1 Objective

The objective of the verification work is to comply with the requirements of paragraph 62 of the CDM Modalities and Procedures. According to this assessment KFQ shall:

- Ensure that the project activity has been implemented and operated as per the revised PDD “*Mokpo Landfill Gas Project for Electricity Generation*” version 05, 29 November 2013<sup>1</sup>, and that all physical features (technology, project equipment, monitoring and metering equipment) of the project are in place;
- Ensure that published Monitoring Report (MR) and other supporting documents provided are complete and verifiable in accordance with applicable methodology and VVS version 04.0 requirements;
- Ensure that actual monitoring systems and procedures comply with the monitoring systems described in the monitoring plan and the approved methodology; and
- Evaluate the data recorded and stored as per the ‘Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories’ AMS-I.D (version 13) and AMS-III.G (version 6).

Verification is the periodic independent review and ex-post determination by the DOE of the monitored reductions in anthropogenic emissions by sources of GHGs that have occurred as a result of a registered CDM project activity during the verification period, and its results give

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basic information for the issuance of Certified Emission Reductions (CERs). For this purpose, KFQ performs the review of documents provided by the PP, monitoring results and the on-site assessment to ensure the conformity of the actual project activity and its operation with the revised PDD.

## **1.2 Scope**

Verification scope is defined as an independent and objective review and ex-post determination by the Designated Entity of the monitored reduction in GHG emissions. The verification is based on the monitoring report provided, the validated project design document and other relevant documents. These documents are reviewed against Kyoto Protocol requirements, UNFCCC rules and associated interpretations. KFQ, based on the recommendations in the Validation and Verification Standard, employs a risk-based approach in the verification, focusing on the identification of significant risks and reliability of project monitoring and generation of CERs.

The verification shall consider both quantitative and qualitative information on emission reductions. Quantitative data comprises the monitoring report submitted to the verifier by the project participant. Qualitative data comprises information on internal management controls, calculation procedures and procedures for transfer, frequency of emissions reports, review and internal audit of calculations/data transfers.

The verification is not meant to provide any consultancy towards the client. However, stated requests for clarifications, corrective and/or forward actions may provide input for improvement of the monitoring activities.

## **1.3 Description of the Project Activity**

Mokpo Landfill Gas Recovery Project for Electricity Generation is developed by Hanwha Corporation in the Republic of Korea. The purpose of this project is to collect and utilize CH<sub>4</sub> (as a renewable energy) for electricity generating at the landfill site. Two generators are installed with a total capacity of 2.123 MW (1.065MW and 1.058MW) and the generating electricity from the project is exporting to a Grid. The estimated annual average emission

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<sup>1</sup> The post registration change has been requested and the PDD has been revised during this 4th verification. The registered PDD referred in this verification report can also refer to the revised PDD. For details on post registration change, please see CAR 4 and CL 3.

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reductions are 25,795 tons CO<sub>2</sub>e over the crediting period.

The physical components including the equipment for collecting LFG and generating electricity and measuring LFG and generated electricity were confirmed as proposed in the PDD.

Project Title	Mokpo Landfill Gas Recovery Project for Electricity Generation
UNFCCC Registration Number	2834
Project Participants	Hanwha Corporation – Republic of Korea Hanwha Corporation - Switzerland
Location of the project	Daeyang-dong, Mokpo City, Jeollanam-do, Republic of Korea. (longitude of 34.8328 N and latitude of 126.4096 E)
Date of registration	18/02/2010
Crediting period	18/02/2010 ~ 17/02/2020
Monitoring period of this verification	19/08/2012~18/08/2013

CAR 5 and CL 3 were raised in the course of the verification and was successfully closed (Ref. Annex: Verification Protocol – Table 3).

## 2 METHODOLOGY

The verification process is based on the approach depicted in the Validation and Verification Standard. Standard auditing techniques have been adopted for the verification process. The verification team performs first a desk review, followed by an on-site visit, which results in the formation of a protocol that includes all findings. The next step involves the evaluation of the findings through direct communication with the PPs and then finally the preparation of the verification report.

This verification report and other supporting documents then undergo an internal quality control before submission to the CDM-EB.

In order to ensure transparency, a verification checklist was customized for the project,

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according to the VVS. The checklist shows, in a transparent manner, criteria (requirements), means of verification and the results. The verification checklist serves the following purposes:

- It organizes, details, and clarifies the requirements a CDM project which is expected to meet:
- It ensures a transparent verification process where the verifier will document how a particular requirement has been proved and the result of verification.

The completed checklist is enclosed in Appendix A to this report.

The verification team consisted as follows:

Eun Jung KIM (Audit team leader, GHG auditor)

Jin Seok CHO (Auditor team member, GHG auditor)

Technical review was undertaken by a technical reviewer, Sung Han YOON.

The qualification of each individual verification team member and the technical reviewer are detailed in Appendix B and Appendix C to this report.

### **2.1 Review of Documentation**

The monitoring report version 1 (05/08/2013) was submitted by the PP and additional background documents related to the project performance were reviewed. A complete list of all documents reviewed is shown in References. The monitoring report was made publicly available on the UNFCCC website on 6 August 2013.

The aim of the assessment in the desk review was to:

- verify the compliance of the MR with the guidance for completing the monitoring report form
- verify the completeness of the data and the information presented in the MR,
- check the compliance of the MR with respect to the monitoring plan and verify that the applied methodology was carried out. Particular attention to coverage of all monitoring parameters, the frequency of measurements, the quality of the metering equipment including calibration requirements, and the quality assurance and quality control



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procedures was paid,

- review the calculations and assumptions used to obtain the GHG data and ER
- evaluate the data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

## **2.2 On-site assessment and follow-up interviews**

On 20 August 2013, KFQ performed a physical site inspection and on-site interviews with project stakeholders to:

- confirm the implementation and operation of the project,
- review the data flow for generating, aggregating and reporting the monitoring parameters,
- confirm the correct implementation of procedures for operations and data collection,
- cross-check the information provided in the MR documentation with other sources,
- check the monitoring equipment against the requirements of the PDD and the approved methodology, including calibrations, maintenance, etc.,
- identify if the quality control and quality assurance procedures are in place to prevent or correct errors or omissions in the reported parameters.

A list of the persons interviewed during this verification activity is included in Table 1.

**Table 1 Interview topics**

<b>Interviewed organisation</b>	<b>Interview topics</b>
Hanwha Corporation - Kun Hong LEE - JIN Young CHOI  Econetwork Co., Ltd (Consulting company) - Seon Young MOON - Yeah Won KIM	- Changes of project design and implementation since validation/initial verification - Compliance of the monitoring plan with the monitoring methodology - Technical equipment and operation - Monitoring data - Data uncertainty and residual risks - Management & operational systems - GHG calculation and reporting procedures - Compliance with National laws and regulations
KPX (Korea Power eXchange) - Yong Hoe HUH	(On-line interview) - Installation of electricity meter and monitoring - National regulation

### **2.3 Resolution of Clarification and Corrective and Forward Action Requests**

The objective of this phase of the verification was to resolve the requests for corrective actions and any other outstanding issues which are needed to be clarified for KFQ's positive conclusion on the GHG emission reduction calculation.

Findings established during the verification can either be seen as a non-fulfillment of criteria ensuring the proper implementation of a project or where a risk to deliver high quality emission reductions is identified.

A Corrective Action Request is raised where KFQ identifies:

- non-conformities in monitoring and/or reporting with the monitoring plan and/or methodology;
- that the evidence provided is not sufficient to prove conformity;
- mistakes in assumptions, data or calculations that impair the ER;
- FARs stated during validation and previous verification that are not solved until the on-site visit.

A Clarification Request is raised where KFQ does not have enough information or the information is not clear in order to confirm a statement or data.

A Forward Action Request is raised where KFQ identifies that monitoring and/or reporting require special attention or adjustments for the next verification period.

To guarantee the transparency of the verification process, the concerns raised and responses that have been given are summarized in chapter 3 below and documented in more detail in the verification checklist in Appendix A.

### **2.4 Internal Quality Control**

According to KFQ's Procedure for deciding whether to proceed request for issuance, the final verification report and verification findings was underwent a technical review before being submitted to the project participants for requesting issuance CERs. The technical review was performed by a technical reviewer qualified in accordance with KFQ's qualification scheme for CDM project validation and verification.

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### **3 VERIFICATION FINDINGS**

In the following sections, the results of the verification are stated. The verification results relate to the project performance as documented and described in the final PDD including its monitoring plan and final Monitoring Report. The verification findings for each verification subject are presented below:

#### **3.1 FARs from previous verification**

FAR was not issued from previous verification.

#### **3.2 Post registration changes**

The issue needed for requesting post registration change was identified by KFQ during this verification. The post registration change was requested in the monitoring plan and it was assessed by KFQ. The changes are summarized as follows:

During this monitoring period, new watt hour meter for measuring imported electricity was installed for 2<sup>nd</sup> generator on 27 January 2013 and has been used since 30 January 2013.

The existing meter (Wa) was measuring exported electricity from both 1<sup>st</sup> generator and 2<sup>nd</sup> generator. As per national regulation, “Act on the promotion of the development, use and diffusion of new and renewable energy”, the electricity generation from 1<sup>st</sup> generator and 2<sup>nd</sup> generator should be measured separately because the commercial operation starting date is different<sup>2</sup>. Accordingly, the PP is requested to measure the electricity generation separately and the PP installed new meter (Wc) to measure electricity from 2<sup>nd</sup> generator in attendance with KPX, the grid company. The validation team reviewed the national regulation and the official document and confirms that the installation of Wc is not within the control of PP.

*Thus, the verification team confirms that the change does not require prior approval by the Board in accordance with appendix 1 of Project standard and post registration change has been requested.*

Wa measures electricity from 1<sup>st</sup> and 2<sup>nd</sup> generators; Wc measures electricity from 2<sup>nd</sup> generator.

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<sup>2</sup> 1<sup>st</sup> generator started commercial operation in September 2008 and 2<sup>nd</sup> generator started commercial operation in June 2009.

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When only 1<sup>st</sup> generator operates or 1<sup>st</sup> and 2<sup>nd</sup> generator operate together<sup>3</sup>, the exported electricity is measured by Wa; when 2<sup>nd</sup> generator operates, the exported electricity is measured by Wc. The verification team confirmed through interviewing the PP and relevant personnel in KPX.

The verification team checked the new meter (Wc) during on-site visit and the accuracy is 0.5S, which is in accordance with the national standard, Operational Directive of Korean Electricity Market controlled by KPX. Also, the accuracy of existing meter (Wa) is 0.5S.

*Thus, the verification team concluded that the applied accuracy of new meter (Wc) do not reduce the level of accuracy of the monitoring compared with the requirements contained in the registered monitoring plan.*

Based on the demonstration above, the verification team can conclude that the proposed revision is appropriate and is in accordance with the applied methodology (AMS I. D version 13 and AMS III. G version 06).

### **3.3 Project Implementation against the registered PDD**

KFQ has performed an on-site assessment to verify the real implementation of the Project as per revised PDD (version 05, dated on 29 November 2013) of the Project activity.

The purpose of this project activity is to collect and utilize LFG for electricity generation with total capacity of 2.123 MW generators (1.065MW and 1.058MW) at the landfill site. This project activity has been implemented as two phase. Firstly, 1.065 MW generator was installed in September 2008 and additional 1.058 MW generator was installed in April 2009. The proposed project has been operated since 18 June 2009 and the verification team confirmed this date through the 'Notification of commercial operation start' sent to local government (Jellanam-do).

MoC for the project was changed to add PP, Hanwha Corporation in Switzerland on 22 December 2011. The verification team confirmed the changed MOC through UNFCCC website<sup>4</sup>.

All facilities and equipment for this project activity are in place as described in the revised

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<sup>3</sup> As for Mokpo LFG power plant, 2<sup>nd</sup> generator is used as auxiliary generator and does not operate in parallel with 2<sup>nd</sup> generator. The verification team confirmed through reviewing the historical data. (Theoretically, when 1<sup>st</sup> and 2<sup>nd</sup> generators operate, the total electricity is measured by Wa.)

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PDD except LFG collecting system (the number of vertical well, well head, and trap). Wells and J-traps were relocated and least-efficient well and J-traps were removed in October 2012<sup>5</sup>. The number of vertical wells in PDD is indicated as 121 but actual total number of installed wells is 149. The verification team checked the construction completion confirmation document. Considering this project site is ongoing dumping waste in landfill site, the change of LFG collecting system to activate LFG gas capture is general situation. The verification team confirmed through checking construction document on-site and the landfill gas collecting system described in the MR is correct and that the project activity has been implemented in accordance with the revised PDD.

During this monitoring period, operation events such as a blackout and maintenance of facilities occurred and verification team checked the daily operation records and measuring data during on-site visit. Through checking the records and data, verification team confirms that PP correctly recorded all operational events in daily operation records and the main operational events have been correctly summarized in the MR (ver.06). [CL 1]

Emission reductions during this monitoring period are 41,686 tCO<sub>2</sub>e and considering 21 GWP of methane the emission reduction is 37,105 tCO<sub>2</sub>e<sup>6</sup> for 365 days and emission reductions as projected in the PDD are 25,623 tCO<sub>2</sub>e for 365 days<sup>7</sup>. Actual emission reductions of this project for monitoring are increased by 46.6%<sup>8</sup> against the emission reduction estimated in the registered PDD. The verification team checked the cause of difference between estimated ER and actual ER as below:

The estimated ER in the PDD is based on 6.16 m<sup>3</sup>/min of LFG flow (average of annual estimated LFG flow) but the actual average LFG flow (8.30 m<sup>3</sup>/min) exceeds the estimated values applied to the ER calculation in the PDD.

Furthermore, the verification team reviewed annual amount of waste quantity since 2007 and found that the amount of waste quantity during 2007 ~ 2013 was increased by 7.2 % than the estimated quantity in registered PDD. As the amount of waste is increased, LFG generation

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<sup>4</sup> <http://cdm.unfccc.int/Projects/DB/emc1249265030.9/view>

<sup>5</sup> The differences of LFG collecting system consisting of well, well trap etc. described in PDD and that at the time of previous monitoring period (1st~3rd) were confirmed at the previous verification respectively.

<sup>6</sup> The emission reduction is 13,668 tCO<sub>2</sub> in 2012 and 28,018 tCO<sub>2</sub> in 2013 for the 4th monitoring period. If methane GWP of 21 is also applied for 2013 (as applied at the validation), the emission reduction would be 37,554 tCO<sub>2</sub>. Thus, emission reduction of 37,554 tCO<sub>2</sub> is compared to the estimated emission reduction of 25,623 tCO<sub>2</sub>.

<sup>7</sup> Estimated ER in the PDD converted into the fourth monitoring period: 25,350 tCO<sub>2</sub>e × 135d/365d + 25,783 tCO<sub>2</sub>e × 230d/365d = 25,623 tCO<sub>2</sub>e

<sup>8</sup> The actual emission reductions have been higher than the estimated emission reductions in the PDD: 43% higher for the 1st (18/02/2010~17/08/2010), 49% for the 2nd (18/08/2010~17/07/2011), and 48% for the 3rd monitoring period (18/07/2011~18/08/2012).

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was increased accordingly.

Also, considering uncertainty and conservativeness of IPCC model applied in methodological tool for estimating LFG generation “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”, this gap is thought to happen (The uncertainty between model and real LFG generation can be seen in the other paper<sup>9</sup>).

In a view point of additionality, increasing treated methane gas is not directly related to income of this project activity. Only power generation increase can affect the additionality. In practice, even the treated LFG was increased, the actual electricity generation (6,214.945 MWh) was not over than the estimated value in the PDD, 6,458.86 MWh<sup>10</sup>. Considering power generator’s efficiency is various based on content of CH<sub>4</sub> and others in LFG, it can be thought that this situation is likely to happen actually.

In conclusion, the verification team confirms that this project activity has been operated in accordance with the registered PDD during this monitoring period.

CL 1 was raised in the course of the verification and was successfully closed (Ref. Annex: Verification Protocol – Table 3).

### **3.4 Compliance of the Monitoring Plan with the Monitoring Methodology**

The verification team confirms that the monitoring plan in the revised PDD (version 05, dated 29 November 2013) is in accordance with the approved methodology, AMS-I.D version 13 and AMS-III.G Version 6 applied by the proposed CDM project activity. Detailed assessment is in separate validation opinion for the revised PDD submitted together with this verification report.

### **3.5 Compliance of the Monitoring with Monitoring Plan**

The monitoring has been carried out in accordance with the monitoring plan in the revised PDD (version 05, dated 29 November 2013). All parameters were monitored and determined

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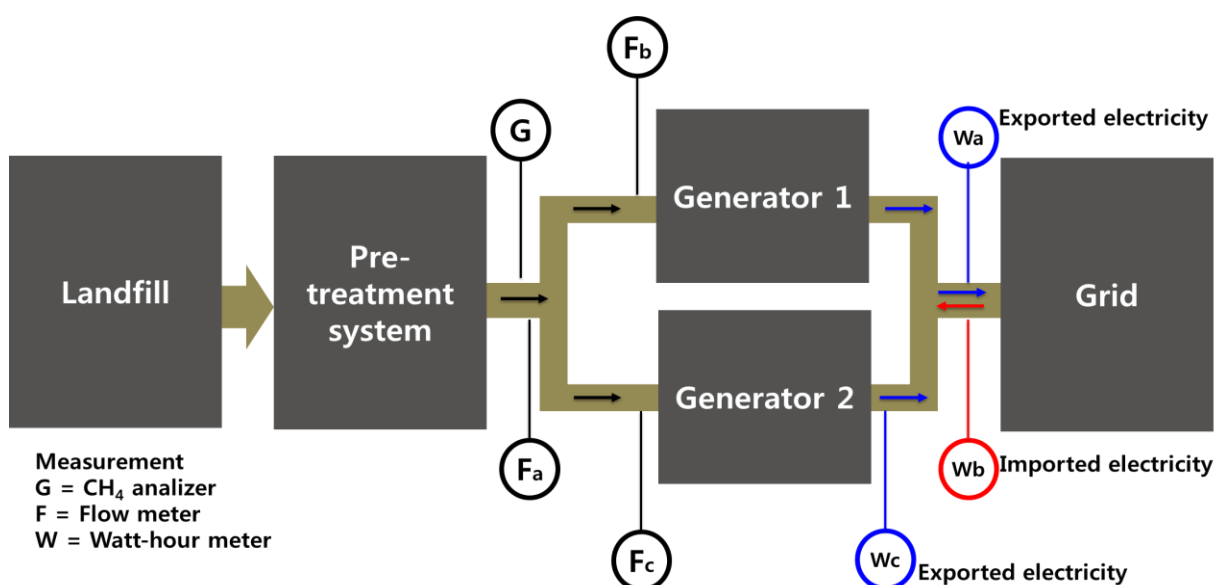
<sup>9</sup> The paper of “A study on the uncertainty analysis of first order decay model for landfill gas” Written by Seung-Kyu Chun, published by Korea Society of Waste Management (Vol. 27, No. 8, 2010) showed that the probability to excess over 20% in the differences between 1st order decay modeling result and real value was 38.9% in uniform distribution, 43.6% in normal distribution (U.R = 4σ)

<sup>10</sup> yearly allocation of estimated power generation in the PDD converted into monitoring days: 6,390 MWh × 135d/365d + 6,499 MWh × 230d/365d = 6,458.86 MWh

as per the revised Monitoring Plan.

Until the 3<sup>rd</sup> monitoring period, 3 flow meters ( $F_a$ ,  $F_b$ ,  $F_c$ ), 1 gas analyzer ( $G$ ) and 2 watt-hour meters ( $W_a$  /  $W_b$ ) were installed for the monitoring and in this 4th monitoring period, 1 watt-hour meter ( $W_c$ ) is added to measure exported electricity from generator 2.

The layout of monitoring equipment is shown in figure 1.



[Figure 1] Layout of monitoring equipment

Before Gas analyzer and LFG flow meter, there is a pre-treatment system. The pre-treatment has moisture removal facility by means of cooling the LFG. From the specification of facility, the output temperature from the facility is designed under 10 °C. From the ‘Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02)’, less 60 °C temperature of gaseous stream is the criteria of dry gas condition. The verification team checked the design data sheet of moisture removal facility installed on the project site and operation status. It is checked that the pre-treatment system is well operated during monitoring period and there was no operation failure through checking daily work log. Thus, it is confirmed that all data of flow meters and gas analyzer were measured under dry basis.

The verification of the parameters required by the monitoring is provided as follows:

Data/Parameter	<b>F</b>
Data Unit	-

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Description	Fraction of methane captured at the SWDS and flared, combusted or used in another manner.
Source of data used	Written information from the operator of the SWDS and/or site visits at SWDS.
Value(s)	0
Means of verification/comments	The verification team checked whether there were changes in the landfill management plan of the site and facilities for LFG treatment against registered PDD through waste management status data published by ministry of environment and physical site inspection. And the verification team confirmed there were no changes for LFG management and any fraction of methane captured and flared, combusted or use in another manner during this monitoring period. Thus, value for this factor is zero during this monitoring period.

Data/Parameter	<b>GWP<sub>CH4</sub></b>
Data Unit	tCO <sub>2</sub> e / tCH <sub>4</sub>
Description	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used	Decisions under UNFCCC and the Kyoto Protocol Decision 4 of CMP 7 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s)	21 for the first commitment period of the Kyoto Protocol 25 for the second commitment period of the Kyoto Protocol
Means of verification/comments	GWP for the first commitment period of the Kyoto Protocol is 21 and GWP for the second commitment period of the Kyoto Protocol is 25. GWP 21 is correctly applied for methane data of 2012 and GWP 25 is correctly applied for methane data of 2013. <b>[CAR 3]</b> <b><u>Please refer to CAR 3.</u></b>

Data/Parameter	<b>LFG<sub>electricity, y</sub></b>
Data Unit	Nm <sup>3</sup> /y
Description	Amount of landfill gas combusted in power plant
Source of data used	Amount of landfill gas combusted in power plant, LFG <sub>electricity, y</sub> is measured by two gas flow meters: F <sub>b</sub> for generator 1 and F <sub>c</sub> for generator 2; total amount of landfill gas combusted in power plant is the sum of value measured by F <sub>b</sub> and F <sub>c</sub> . The data is taken from centralized monitoring system data server and the data sheet is processed and transferred for the ER calculation.



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	During the 4th monitoring period, reserve flow meter was not used for $F_b$ and $F_c$ .																																																														
Value(s)		<table><tr><th rowspan="2">Data</th><th colspan="3">Measured <math>LFG_{electricity,y}</math> (<math>Nm^3</math>)</th></tr><tr><th><math>F_b</math></th><th><math>F_c</math></th><th><math>F_b + F_c</math></th></tr><tr><td>19/08/2012 ~ 18/09/2012</td><td>309,729.0</td><td>36,081.6</td><td>345,810.6</td></tr><tr><td>19/09/2012 ~ 18/10/2012</td><td>288,400.0</td><td>61,150.1</td><td>349,550.1</td></tr><tr><td>19/10/2012 ~ 18/11/2012</td><td>329,476.7</td><td>19,899.9</td><td>349,376.6</td></tr><tr><td>19/11/2012 ~ 18/12/2012</td><td>215,141.8</td><td>94,417.8</td><td>309,559.6</td></tr><tr><td>19/12/2012 ~ 18/01/2013</td><td>392,209.0</td><td>0.0</td><td>392,209.0</td></tr><tr><td>19/01/2013 ~ 18/02/2013</td><td>355,765.0</td><td>15,630.5</td><td>371,395.5</td></tr><tr><td>19/02/2013 ~ 18/03/2013</td><td>280,537.1</td><td>44,150.0</td><td>324,687.1</td></tr><tr><td>19/03/2013 ~ 18/04/2013</td><td>347,325.7</td><td>31,574.7</td><td>378,900.4</td></tr><tr><td>19/04/2013 ~ 18/05/2013</td><td>338,330.7</td><td>33,483.1</td><td>371,813.8</td></tr><tr><td>19/05/2013 ~ 18/06/2013</td><td>368,836.2</td><td>12,557.7</td><td>381,393.9</td></tr><tr><td>19/06/2013 ~ 18/07/2013</td><td>369,924.1</td><td>12,773.3</td><td>382,697.4</td></tr><tr><td>19/07/2013 ~ 18/08/2013</td><td>387,842.4</td><td>18,439.1</td><td>406,281.5</td></tr><tr><td>19/08/2012 ~ 18/08/2013</td><td>3,983,517.7</td><td>380,157.8</td><td>4,363,675.5</td></tr></table>			Data	Measured $LFG_{electricity,y}$ ( $Nm^3$ )			$F_b$	$F_c$	$F_b + F_c$	19/08/2012 ~ 18/09/2012	309,729.0	36,081.6	345,810.6	19/09/2012 ~ 18/10/2012	288,400.0	61,150.1	349,550.1	19/10/2012 ~ 18/11/2012	329,476.7	19,899.9	349,376.6	19/11/2012 ~ 18/12/2012	215,141.8	94,417.8	309,559.6	19/12/2012 ~ 18/01/2013	392,209.0	0.0	392,209.0	19/01/2013 ~ 18/02/2013	355,765.0	15,630.5	371,395.5	19/02/2013 ~ 18/03/2013	280,537.1	44,150.0	324,687.1	19/03/2013 ~ 18/04/2013	347,325.7	31,574.7	378,900.4	19/04/2013 ~ 18/05/2013	338,330.7	33,483.1	371,813.8	19/05/2013 ~ 18/06/2013	368,836.2	12,557.7	381,393.9	19/06/2013 ~ 18/07/2013	369,924.1	12,773.3	382,697.4	19/07/2013 ~ 18/08/2013	387,842.4	18,439.1	406,281.5	19/08/2012 ~ 18/08/2013	3,983,517.7	380,157.8	4,363,675.5
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		<p>Measured <math>LFG_{electricity,y}</math> (<math>Nm^3</math>) in above table is calculated by deducting previous measuring data from current measuring data in every recording time because flow meters used are integrating flow meters.</p> <p>Please refer to the spreadsheet of ‘Mokpo_4th MR_R2834_Emission Reduction’ ver.06.0.</p>																																																													
Means of verification/comments	<p>The data of <math>F_b</math> and <math>F_c</math> in the spreadsheet ‘Mokpo_4th MR_R2834_Emission Reduction’ ver.06.0 have been verified against the raw data from server during the on-site visit.</p> <p>The summation data of <math>F_b</math> and <math>F_c</math> has been also crosschecked with another flow meter (Tag: <math>F_a</math>, total flow meter) located on the branch of pipeline to each power generator considering the material balance (<math>F_b + F_c = F_a</math>). Daily data of ‘<math>F_b + F_c</math>’ and ‘<math>F_a</math>’ are compared; the gap (‘<math>F_b + F_c</math>’</p>																																																														

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	<p>– <math>F_a</math>) within unique meter's error range is acceptable (under 2%) considering each meters' uncertainty (1%). The verification team checked the data and confirms that the summation of <math>F_b</math> and <math>F_c</math> was not exceeded the acceptable error range of <math>F_a</math> and thus, is reliable.</p> <p>Each flow meter sends signals continuously to the data server and the accumulated data are registered by electronic file continuously. The type of flow meter is thermal mass flow meter and the measured value is automatically recorded as normalized cubic meters.</p> <p>While the flow data was transferred to the server, data server processing was occasionally delayed; when it occurred, data was not transmitted from flow meter to data server (hereafter this phenomenon is called as data lag). In this case, spot flow data were not recorded but the total flow during the data lag can be measured because the type of measuring equipment is an integrating meter.</p> <p>When flow meter data was not transferred to data server due to data server's malfunction or maintenance of monitoring system (4 January 2013, 19~25 April 2013, etc.), the PP manually recorded the flow rate data every hour according to the emergency procedure in operating manual and applied this data in BE calculation.</p> <p>When the generator for the project was not operated during black out of the project site and maintenance of equipment, the PP considered measured flow data as '0' and applied '0' in BE calculation. Also during generator shifts, flow rates were not available due to measurement error and those flow rates were also applied as '0' in BE calculation. These events are recorded in the operation event history in section B.1 (Table B-1) of the MR.</p> <p>The verification team checked the correlation of <math>LFG_{\text{electricity},y}</math> and <math>EL_{\text{IMP,PJT},y}</math>. There is no considerable peculiarity found.</p> <p>Verification team checked the daily work log, the operating manual, spread sheet of 'Mokpo_4th MR_R2834_Emission Reduction' and raw data sheet of 'LFG flow rates &amp; CH<sub>4</sub> fraction (Mokpo LFG plant)_date' and confirmed that all data applied to BE calculation are consistent and correct.</p>
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<b>Verified Meter's Information</b>				
Description		Main flow	1 <sup>st</sup> Generator (Flow 1)	2 <sup>nd</sup> Generator (Flow 2)
Tag		F <sub>a</sub>	F <sub>b</sub>	F <sub>c</sub>
I.D/ Serial No.		906044B	812003	906044A
Type		Thermal Mass Flow Meter		
Accuracy level		1%		
Calibration frequency		Three years		
Initial test	Testing Date	24-07-2009	18-03-2009	24-07-2009
	Validity	23-07-2012	17-03-2012	23-07-2012
Previous /Latest calibration	Calibration date	02-04-2012 ~ 03-04-2012	02-04-2012 ~ 03-04-2012	02-04-2012 ~ 03-04-2012
	Validity	01-04-2015	01-04-2015	01-04-2015
Applied period		19-09-2012 ~ 18-08-2013	19-09-2012 ~ 18-08-2013	19-09-2012 ~ 18-08-2013
The applied period of max. permissible error when applicable		-	-	-
Calibration Entity		Flow Technology Co., Ltd.		
Means of verification/comments		<p>According to the approved revised monitoring plan, PP decided to adopt three (3) years of calibration frequency and accuracy level of these meters are 1%.</p> <p>All three flow meters are valid to measure the amount of landfill gas combusted in power plant during this monitoring period.</p>		

Data/Parameter	W <sub>CH<sub>4</sub>,y</sub>	
Data Unit	%	
Description	Methane fraction in LFG	
Source of data used	Methane fraction in LFG is measured by a methane analyzer and the data is taken from centralized monitoring system data server.	
Value(s)	Data	Weighted average CH <sub>4</sub> concentration (%)
	19/08/2012~31/12/2012	54.90
	01/01/2013~18/08/2013	50.59

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	<p>Please refer to the spread sheet of 'Mokpo_4th MR_R2834_Emission Reduction' ver.06.0.</p>
Means of verification/comments	<p>The gas analyzer is located in front of total flow meter (<math>F_a</math>). Gas analyzer sends signals continuously to the data server (centralized monitoring system). <math>W_{CH_4,y}</math> in spreadsheet of 'Mokpo_4th MR_R2834_Emission Reduction' have been verified against server data during the site visit.</p> <p>Methane fraction in LFG is continuously measured and recorded in the data server with the same frequency of the flow.</p> <p>As explained in flow data of LFG, data lag occasionally occurred, when the concentration of <math>CH_4</math> was transferred to the server. Thus, the PP took conservative approach to adopt <math>CH_4</math> concentration during the data vacancy period; that is, <math>CH_4</math> value is determined as a lower value comparing measured data with previous measured data in every recording time.</p> <p>This correction logic is applied in the raw data sheet of 'LFG flow rates &amp; <math>CH_4</math> fraction (Mokpo LFG plant)_date' and BE is calculated with this corrected data. The verification team confirmed this approach is conservative and correctly applied to BE calculation.</p> <p>When <math>CH_4</math> concentration data was not transferred to data server due to data server's malfunction or maintenance of monitoring system (4 January 2013, 19~25 April 2013, etc.), the PP manually recorded the <math>CH_4</math> concentration data every hour according to the emergency procedure in operating manual and applied this data in BE calculation as explained in flow data of LFG. The verification team reviewed hourly <math>CH_4</math> concentration recorded by PP at the time of problem of monitoring system and confirmed methane analyzer functioned properly at that time through daily work log. <b>[CAR 1]</b></p> <p>Also during generator shifts, <math>CH_4</math> concentration was not available due to measurement error and the PP applied <math>CH_4</math> concentration of '0%' to BE calculation in a conservative manner. These events can be identified in the event history in section B.1 (Table B-1) of MR.</p> <p>Verification team checked the daily work log, the operating manual,</p>

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		spread sheet of ‘Mokpo_4th MR_R2834_Emission Reduction’ and raw data sheet of ‘LFG flow rates & CH <sub>4</sub> fraction (Mokpo LFG plant)_date’ and confirms that all data applied to BE calculation are consistent and reliable.		
		<b><u>Please refer to CAR 1.</u></b>		
<b>Verified Meter’s Information</b>				
Tag		G		
I.D/ Serial No.		A8M7282T		
Type		Methane analyzer	Accuracy level	Linearity 1%, Repeatability 0.5%
Calibration Entity		Fuji Electric Instrumentation Co., Ltd. (initial test) KRISS (National Metrology Institute) (latest calibration)	Calibration frequency	Three years
Previous calibration (initial test)	Test date	09-04-2009		
	validity	08-04-2012		
Latest calibration	Test date	02-04-2012		
	validity	01-04-2015		
Applied period		19-08-2012 ~ 18-08-2013		
The applied period of max. permissible error when applicable		-		
Means of verification/comments		<p>According to the monitoring plan in the revised PDD, PP decided to adopt three (3) years of calibration frequency and accuracy level of this meters are 1% (as a linearity).</p> <p>The verification team reviewed initial test report (9 April 2009) issued by Fuji Electric Instrumentation Co., Ltd. and second test report (2 April 2012) issued by KRISS (National Metrology Institute) and confirmed that the gas analyzer is valid to measure methane concentration and no delayed calibration occurred during this monitoring period.</p> <p>In addition to zero/span calibration, according to the manufacture’s recommendation, regular testing for gas analyzer was done once a month in two ways, zero and span calibration. Zero calibration is to set zero of analyzer using certified N<sub>2</sub> gas. Span calibration is for span point adjustment. For span calibration, certified standard gases (CH<sub>4</sub>, CO<sub>2</sub> and O<sub>2</sub>) were used.</p>		

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	Record of each regular calibration report, certification and purchase record of standard gases had been provided to the verification team and were identified. All calibration report show that the gas analyzer operated normally during the monitoring period (All errors found from the test is smaller than the maximum permissible error of zero and span test).
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Data/Parameter	$EL_{EXP,PJT,y}$			
Data Unit	MWh			
Description	Amount of exported electricity			
Source of data used	<p>The amount of exported electricity is measured automatically by two watt-hour meters:</p> <p>Until 29 January 2013, Wa is used to measure generated electricity from generator 1 and generator 2.</p> <p>From 30 January 2013, Wa is used when generator 1 operates or generator 1 and only 2 operate; Wc is used when generator 2 operates.</p> <p><b>[CAR 4]</b></p> <p>The data is crosschecked with sales receipts of KPX.</p>			
Value(s)	Date	Wa	Wc	Measured $EL_{EXP}$ (MWh)
	19/08/2012 ~ 18/09/2012	480.752	-	480.752
	19/09/2012 ~ 18/10/2012	449.216	-	449.216
	19/10/2012 ~ 18/11/2012	524.652	-	524.652
	19/11/2012 ~ 18/12/2012	460.767	-	460.767
	19/12/2012 ~ 18/01/2013	564.866	-	564.886
	19/01/2013 ~ 18/02/2013	546.699	0	546.699
	19/02/2013 ~ 18/03/2013	432.365	60.572	492.937
	19/03/2013 ~ 18/04/2013	515.013	44.453	559.466
	19/04/2013 ~ 18/05/2013	483.165	43.905	527.069
	19/05/2013 ~ 18/06/2013	524.030	17.906	541.126
	19/06/2013 ~ 18/07/2013	509.255	16.711	525.966
	19/07/2013 ~ 18/08/2013	518.423	23.004	541.428
	19/08/2012 ~ 18/08/2013	6,009.204	205.740	6,214.945

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Means of verification/comments	<p>Wc is installed on 27 January 2013 and has been used since 30 January 2013. Until 29 January 2013, Wa measures generated electricity from 1<sup>st</sup> and 2<sup>nd</sup> generators.</p> <p>Until 29 January 2013, Wa is used to measure generated electricity from generator 1 and generator 2. From 30 January 2013, Wa measures generated electricity from 1st and 2nd generators; Wc measures electricity from 2nd generator. When only 1st generator operates or 1<sup>st</sup> and 2<sup>nd</sup> generators operate together <sup>11</sup>, the exported electricity is measured by Wa; when only 2nd generator operates, the exported electricity is measured by Wc. The verification team confirmed through interviewing the PP and relevant personnel in KPX. [CAR 4]</p>	
	<p>The hourly measured data are transferred to E-power Market of KPX (Korea Power Exchange) and achieved daily, weekly and monthly in electronic way automatically. And Mokpo LFG power operating team checked daily data and recorded in the work log. EL<sub>EXP,PJT,y</sub> in the spread sheet of ‘Mokpo_4th MR_R2834_Emission Reduction’ have been verified against the data from E-power Market of KPX during the site visit.</p>	
	<p>Verification team checked that total amount of electricity exported to grid during this monitoring period is 6,214.945 MWh and concluded that this value is correct.</p>	
	<p><b><u>Please refer to CAR 4.</u></b></p>	
<b>Verified Meter’s Information</b>		
Tag	W <sub>a</sub>	W <sub>c</sub>
I.D/ Serial No.	95246742	50339836
Type	Watt-hour meter	Watt-hour meter
Accuracy level	0.5S	0.5S
Calibration Entity	Meter and Petrochemical testing and research Institute (initial test) Korea Testing Certification (latest calibration)	Korea Testing Certification
Calibration frequency	Two years	Two years

<sup>11</sup> As for Mokpo LFG power plant, 2<sup>nd</sup> generator is used as auxiliary generator and does not operate in parallel with 2<sup>nd</sup> generator. The verification team confirmed through reviewing the historical data. (Theoretically, when 1<sup>st</sup> and 2<sup>nd</sup> generators operates, the total electricity is measured by Wa.)

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Previous calibration (Initial test)	Test date	28-08-2008	04/01/2013
	validity	27-08-2010	03/01/2015
Second calibration	Test date	25-08-2010	
	validity	24-08-2012	
Latest calibration	Test date	23-08-2012	
	validity	22-08-2014	
Applied period		19-08-2012 ~ 18-08-2013	30/01/2013~18/08/2013
The applied period of max. permissible error when applicable		-	-
Means of verification/comments		According to the approved revised monitoring plan, PP decided to adopt two (2) years of calibration frequency and accuracy level of these meters are 0.5s. The verification team reviewed initial test report (28 August 2008) issued by Meter and Petrochemical testing and research Institute, second test report (25 August 2010) issued by Korea Testing Certification, and latest calibration report (23 August 2012) for Wa and initial test report (9 January 2013) by Korea Testing Certification for Wc. It is confirmed the watt-hour meters for exported electricity are valid to measure electricity exported to the grid for this monitoring period.	

Data/Parameter	EL <sub>IMP,PJT,y</sub>
Data Unit	MWh
Description	Amount of imported electricity meter
Source of data used	The amount of imported electricity is measured automatically by certified watt-hour meter and can be checked from the bill issued by KEPCO.



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Value(s)			Date	Measured EL <sub>IMP</sub> (MWh)
			19/08/2012 ~ 18/09/2012	0.312
			19/09/2012 ~ 18/10/2012	0.312
			19/10/2012 ~ 18/11/2012	0.144
			19/11/2012 ~ 18/12/2012	0.696
			19/12/2012 ~ 18/01/2013	0.672 <sup>12</sup>
			19/01/2013 ~ 18/02/2013	0.504
			19/02/2013 ~ 18/03/2013	0.240
			19/03/2013 ~ 18/04/2013	0.096
			19/04/2013 ~ 18/05/2013	0.144
			19/05/2013 ~ 18/06/2013	0.048
			19/06/2013 ~ 18/07/2013	0.096
			19/07/2013 ~ 18/08/2013	0.024
			19/08/2012~18/08/2013	3.288
	Means of verification/comments		The amount of imported electricity is measured automatically by certified watt-hour meter and monthly bills for imported electricity are issued by KEPCO.	
The verification team checked the monthly bills from KEPCO on total amount of electricity imported from grid during this monitoring period and confirms that the amount of imported electricity is 3.288 MWh during this monitoring period. [CAR 2] <b><u>Please refer to CAR 2.</u></b>				
Verified Meter's Information				
Tag		W <sub>b</sub>		
I.D/ Serial No.		0190662		
Type		Watt-hour meter	Accuracy level	1S
Calibration Entity		LS industrial Co., Ltd. (Initial test) Korea Testing Certification (KTC) (Latest calibration)	Calibration frequency	Two (2) years
Previous calibration (Initial	Test date	22-08-2008		
	validity	21-08-2010		

<sup>12</sup> The imported electricity for 19/12/2012 ~ 18/01/2013 is 0.336 MWh and the imported electricity can not be allocated daily basis because there is no daily imported electricity record. Thus, 0.336 MWh is applied for 19/12/2012 ~ 31/12/2012 and 01/01/2013 ~ 18/01/2013 respectively to conservatively calculate emission reductions achieved up to 31/12/2012 and from 01/01/2013. [CAR 2]

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test)		
Latest calibration	Test date	27-09-2011
	validity	26-09-2013
The applied period of max. permissible error when applicable		19-08-2012 ~ 18-08-2013
Means of verification/comments		<p>According to the approved revised monitoring plan, PP decided to adopt two (2) years of calibration frequency and accuracy level of this meter is 1S.</p> <p>The verification team reviewed the test reports and confirmed that the gas analyzer is valid to measure imported electricity and no delayed calibration occurred during this monitoring period.</p>

In conclusion, verification team confirms that monitoring of this project activity was performed in accordance with revised monitoring plan.

### 3.6 Assessment of Data and Calculation of Greenhouse Gas Emission Reductions

All the parameters defined in the revised monitoring plan have been monitored in accordance with the revised monitoring plan. Thus, all data are available. The reported data have been cross-checked against other sources available.

The verification team verified the following parameters:

- Amount of landfill gas combusted in power plant
- Methane fraction in LFQ
- Amount of exported electricity
- Amount of imported electricity

The verification team also confirms that the methods and formulae used to obtain the baseline/project emissions and emission reduction are appropriate. And the calculation in “Mokpo Landfill gas CDM project 4<sup>th</sup> Monitoring Report” is correct.

Those have been done in accordance with the methods and formulae described in the revised PDD and applicable methodologies, AMS I.D version 13, AMS-III. G version 06).

The calculation of emission reduction is as follows:

$$ER_y = BE_y - PE_y - LE_y$$

Baseline emission is calculated as follows:

$$BE_y = (MD_y - MD_{reg,y}) + EL_{EXP, PJT, y} * CEF$$

Parameter	Unit	Description
$MD_y$	tCO <sub>2e</sub>	CO <sub>2</sub> equivalent of the methane captured and destroyed/ gainfully used by the project activity in year y;
$MD_{reg,y}$	tCO <sub>2e</sub>	Methane emissions that would be captured and destroyed to comply with national or local safety requirements or legal regulations in the year ‘y’
$EL_{EXP, PJT, y}$	MWh	The quantity of electricity exported to the grid-connected system by this project activity during the year, y
CEF	tCO <sub>2e</sub> /MWh	Combined emission factor in electricity generation by grid-connected system; weighted average of EFOM and EFBM.

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The verification team confirms that the emission factor (ex-ante values from PDD, 0.5375 tCO<sub>2e</sub>/MWh) is already justified and applied correctly for emission reduction calculation. No assumptions and default values are applied for the calculation.

Where,

$$MD_y = LFG_{electricity,y} * w_{CH_4,y} * D_{CH_4,y} * GWP_{CH_4}$$

Parameter	Unit	Description
$LFG_{electricity,y}$	Nm <sup>3</sup>	Landfill gas flared or used as fuel in the year 'y'
$w_{CH_4,y}$	%	Methane content in landfill gas in the year 'y' (mass fraction)
$D_{CH_4,y}$	ton/ Nm <sup>3</sup>	Density of methane at the temperature and pressure of the landfill gas in the year 'y' (0.0007168 ton/Nm <sup>3</sup> -CH <sub>4</sub> ) In this project activity, $LFG_{electricity,y}$ was monitored as Nm <sup>3</sup> with thermal mass flow meter. Thus, the density of methane under STP (Standard temperature and pressure, 0 degree Celsius and 1,013 bar) was applied and the value of density of methane is quoted from the methodology ACM0001 (ver. 11)
$GWP_{CH_4}$	tCO <sub>2</sub> /tCH <sub>4</sub>	Global warming potential of methane (21 CO <sub>2e</sub> /CH <sub>4</sub> for the 1st commitment period of Kyoto Protocol 25 CO <sub>2e</sub> /CH <sub>4</sub> for the 2nd commitment period of Kyoto Protocol)

Project emission is calculated as follows:

$$PE_y = EL_{IMP, PJT, y} * CEF$$

Parameter	Unit	Description
$EL_{IMP, PJT, y}$	MWh	The quantity of electricity imported from grid-connected system by project activity during the year, y

Also, the verification team confirms that the calculation was correctly implemented according to the applied formulae used to obtain the baseline emissions through checking spread sheet of 'Mokpo\_4th MR\_R2834\_Emission Reduction' and raw data sheet of 'LFG flow rates & CH<sub>4</sub> fraction (Mokpo LFG plant)\_date' and the calculation result is appropriate.

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Baseline emission

$$BE_y = (MD_y - MD_{reg,y}) + EL_{EXP, PJT, y} * CEF$$

$$= (LFG_{electricity,y} * w_{CH4,y} * D_{CH4,y} * GWP_{CH4} - MD_{reg,y}) + EL_{EXP, PJT, y} * CEF$$

The amount of LFG consumption in power generation ( $LFG_{electricity,y}$ ) during this monitoring period from 19 August 2012 to 18 August 2013 is 4,363.675.5 Nm<sup>3</sup> and weighted average methane concentration of LFG is 52.09 %. There is no other LFG treatment activity by regulation in the site. It was already justified that MD<sub>reg,y</sub> is 0 at validation and verification team checked that there was no change of regulation for LFG treatment in the project site.

The electricity exported electricity to the grid ( $EL_{EXP, PJT, y}$ ) is 6,214.945 MWh during this monitoring period. The verification team confirms the Baseline Emission in the excel spreadsheet is correct.

Period	$LFG_{electricity,y}$ (Nm <sup>3</sup> )	$w_{CH4,y}$ (%)	$EL_{EXP, PJT, y}$ (MWh)	Applied Value for BE (tCO <sub>2e</sub> )
19/08/2012 ~ 18/09/2012	345,810.6	57.705	480.752	3,262.205
19/09/2012 ~ 18/10/2012	349,550.1	54.816	449.216	3,125.694
19/10/2012 ~ 18/11/2012	349,376.6	54.547	524.652	3,150.667
19/11/2012 ~ 18/12/2012	309,559.6	54.696	460.767	2,796.369
19/12/2012 ~ 31/12/2012	160,071.9	50.198	232.282	1,334.388
19/08/2012 ~ 31/12/2012	1,514,368.8	54.901	2,147.670	13,669.323
01/01/2013 ~ 18/01/2013	232,137.1	48.741	332.584	2,206.354
19/01/2013 ~ 18/02/2013	371,395.5	47.686	546.699	3,467.524
19/02/2013 ~ 18/03/2013	324,687.1	48.222	492.937	3,070.694
19/03/2013 ~ 18/04/2013	378,900.4	49.106	559.466	3,634.957
19/04/2013 ~ 18/05/2013	371,813.8	49.198	527.069	3,561.294
19/05/2013 ~ 18/06/2013	381,393.9	52.268	541.126	3,863.185
19/06/2013 ~ 18/07/2013	382,697.4	54.422	525.966	4,014.916
19/07/2013 ~ 18/08/2013	406,281.5	53.696	541.428	4,200.398
01/01/2013 ~ 18/08/2013	2,849,306.7	50.594	4,067.275	28,019.323
<b>Total</b>	<b>4,363,675.5</b>	<b>52.09</b>	<b>6,214.945</b>	<b>41,688.646</b>

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Project emission

$$PE_y = EL_{IMP, PJT, y} * CEF$$

The electricity imported electricity to the grid ( $EL_{IMP, PJT, y}$ ) is 3.288 MWh during this monitoring period.

$$PE_y = 3.288 \text{ MWh} \times 0.5375 \text{ tCO}_2\text{e/MWh} = 1.767 \text{ tCO}_2\text{e}$$

The verification team confirms the below Project Emission data in the excel spreadsheet is correct.

Period	$EL_{IMP, PJT, y}$ (MWh)	Applied Value for <i>PE</i> (tCO <sub>2</sub> e)
19/08/2012 ~ 18/09/2012	0.312	0.1677
19/09/2012 ~ 18/10/2012	0.312	0.1677
19/10/2012 ~ 18/11/2012	0.144	0.0774
19/11/2012 ~ 18/12/2012	0.696	0.3741
19/12/2012 ~ 31/12/2012	0.336	0.1806
19/08/2012 ~ 31/12/2012	1.800	0.9675
01/01/2013 ~ 18/01/2013	0.336 <sup>13</sup>	0.1806
19/01/2013 ~ 18/02/2013	0.504	0.2709
19/02/2013 ~ 18/03/2013	0.240	0.1290
19/03/2013 ~ 18/04/2013	0.096	0.0516
19/04/2013 ~ 18/05/2013	0.144	0.0774
19/05/2013 ~ 18/06/2013	0.048	0.0258
19/06/2013 ~ 18/07/2013	0.096	0.0516
19/07/2013 ~ 18/08/2013	0.024	0.0129
01/01/2013 ~ 18/08/2013	1.488	0.7998
<b>Total</b>	<b>3.288</b>	<b>1.767</b>

Leakage

Emissions due to leakage are zero according to the revised PDD.

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<sup>13</sup> The imported electricity for 19/12/2012 ~ 18/01/2013 is 0.336 MWh and the imported electricity can not be allocated daily basis because there is no daily imported electricity record. Thus, 0.336 MWh is applied for 19/12/2012 ~ 31/12/2012 and 01/01/2013 ~ 18/01/2013 respectively to conservatively calculate emission reductions achieved up to 31/12/2012 and from 01/01/2013.

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Emission reductions

$$ER_y = BE_y - PE_y - LE_y$$

And  $LE_y$  is 0,

Thus, emission reductions are calculated as belows and the verification team confirms that the Emission Reduction data in the excel spreadsheet and the MR is correct.

<b>Period</b>	<b>Applied Value for <i>BE</i> (tCO<sub>2</sub>e)</b>	<b>Applied Value for <i>PE</i> (tCO<sub>2</sub>e)</b>	<b>Verified <i>ER<sub>y</sub></i> (tCO<sub>2</sub>e)</b>
19/08/2012 ~ 18/09/2012	3,262.205	0.1677	3,262.037
19/09/2012 ~ 18/10/2012	3,125.694	0.1677	3,125.527
19/10/2012 ~ 18/11/2012	3,150.667	0.0774	3,150.589
19/11/2012 ~ 18/12/2012	2,796.369	0.3741	2,795.995
19/12/2012 ~ 31/12/2012	1,334.388	0.1806	1,334.208
19/08/2012 ~ 31/12/2012	13,669.323	0.9675	13,668.356
01/01/2013 ~ 18/01/2013	2,206.354	0.1806	2,206.173
19/01/2013 ~ 18/02/2013	3,467.524	0.2709	3,467.253
19/02/2013 ~ 18/03/2013	3,070.694	0.1290	3,070.565
19/03/2013 ~ 18/04/2013	3,634.957	0.0516	3,634.906
19/04/2013 ~ 18/05/2013	3,561.294	0.0774	3,561.217
19/05/2013 ~ 18/06/2013	3,863.185	0.0258	3,863.159
19/06/2013 ~ 18/07/2013	4,014.916	0.0516	4,014.864
19/07/2013 ~ 18/08/2013	4,200.398	0.0129	4,200.386
01/01/2013 ~ 18/08/2013	28,019.323	0.7998	28,018.523
<b>Total</b>	<b>41,688.646</b>	<b>1.767</b>	<b>41,686.879</b>

Thus, emission reductions up to 31 December 2012 is confirmed to be 13,668 tCO<sub>2</sub>e and Emission reductions from 1 January 2013 is confirmed to be 28,018 tCO<sub>2</sub>e.

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ERs in MR (version 1) opened to the public on 5 August 2013 are 27,176 tCO<sub>2</sub>e, whereas ERs in revised MR (version 6.0) is 41,686 tCO<sub>2</sub>e.

Period	Value in MR_open (tCO <sub>2</sub> e)	Verified Value in MR_final (tCO <sub>2</sub> e)
19/08/2012 ~ 18/09/2012	3,262.037	3,262.037
19/09/2012 ~ 18/10/2012	3,125.527	3,125.527
19/10/2012 ~ 18/11/2012	3,150.589	3,150.589
19/11/2012 ~ 18/12/2012	2,795.995	2,795.995
19/12/2012 ~ 18/01/2013	3,216.147	3,540.381
19/01/2013 ~ 18/02/2013	2,959.466	3,467.253
19/02/2013 ~ 18/03/2013	2,621.646	3,070.565
19/03/2013 ~ 18/04/2013	3,101.427	3,634.906
19/04/2013 ~ 18/05/2013	2,943.262	3,561.217
19/05/2013 ~ 18/06/2013	-	3,863.159
19/06/2013 ~ 18/07/2013	-	4,014.864
19/07/2013 ~ 18/08/2013	-	4,200.386
<b>Total</b>	<b>27,176.096</b>	<b>41,686.879</b>
<b>Total rounded down</b>	<b>27,176</b>	<b>41,686</b>

The difference of the value between opened MR (version 1) and revised MR (version 6.0) mainly results application of GWP<sub>CH<sub>4</sub></sub> for second commitment period of Kyoto protocol and the extension in monitoring period. (Please refer to CAR 3, CAR 5, and CL 2).

The values of each parameter for ER calculation during this monitoring period in MR (version 1) and in revised MR (version 6.0) are summarized as follows;

Data verified for ER calculation

Parameter	Value in MR ver.1	Verified Value (MR ver.6.0)	Unit/Remark
LFG <sub>electricity,y</sub>	3,180,437.10	4,363,675.5	Nm <sup>3</sup>
W <sub>CH<sub>4</sub>,y</sub>	51.6%	54.90 for 19/18/2012~31/12/2012 50.59 for 01/01/2013~18/08/2013	Weighted average value during monitoring period
D <sub>CH<sub>4</sub>,y</sub>	0.0007168	0.0007168	ton ton/Nm <sup>3</sup> -CH <sub>4</sub>



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$GWP_{CH_4}$	21	21 for 2012 monitoring data 25 for 2013 monitoring data	$tCO_2e/tCH_4$
$EL_{EXP, PJT, y}$	4,606.426	6,214.945	MWh
$EL_{IMP, PJT, y}$	2.784	3.288	MWh
CEF	0.5375	0.5375	$tCO_2e/MWh$

As required in AMS III. G,  $LFG_{electricity, y}$  ( $F_b$ ,  $F_c$ ),  $w_{CH_4, y}$  are continuously monitored. The real-time data of these parameters have been measured running every 10 seconds in data processing program. Consequently, the total file size of all raw data sheet of 'LFG flow rates &  $CH_4$  fraction (Mokpo LFG plant)\_date' is around 4.68 GB and it is technically difficult to upload such raw data sheet of 'LFG flow rates &  $CH_4$  fraction (Mokpo LFG plant)\_date'. Therefore, daily value for  $LFG_{electricity, y}$  and weighted average value for  $w_{CH_4, y}$  are taken from the raw data sheet of 'LFG flow rates &  $CH_4$  fraction (Mokpo LFG plant)\_date' to the spread sheet of 'Mokpo\_4th MR\_R2834\_Emission Reduction' for this entire monitoring period. The verification team confirmed all data applied to ER calculation in raw data of 'LFG flow rates &  $CH_4$  fraction (Mokpo LFG plant)\_date', spreadsheet of 'Mokpo\_4th MR\_R2834\_Emission Reduction' and MR are consistent.

### 3.7 Management system and quality assurance

The PP, Hanwha Corporation has the overall authority and responsibility for project operation. Also, PP has the responsibility for the monitoring of all parameters for the calculation of emission reduction accounting and reporting.

The relevant procedures regarding the management system and quality assurance have been described in Operating manual-Mokpo LFG Power Plant- Monitoring of PP and it has been appropriately implemented.

The key parameters have been measured and recorded in the respective documents and electronic form. And data protection measures are adequately implemented.

The designed staffs for monitoring of the project are duly trained by equipment managing

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VERIFICATION AND CERTIFICATION REPORT

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system manufacturer (for program operating, maintenance of computer system and measuring equipment, power and signal line maintenance etc.), internal CDM expert (for general and technical knowledge of CDM), and KPX (for safety and knowledge of grid operating) as described in the monitoring plan.

## **4 VERIFICATION STATEMENT AND CERTIFICATION REPORT**

Korean Foundation for Quality has performed the fourth verification of the CDM project: “Mokpo Landfill Gas Recovery Project for Electricity Generation” which is registered. The verification is based on the currently valid documentation of the UN Framework Convention on Climate Change (UNFCCC).

Hanwha Corporation is responsible for the preparation of the GHG emissions data and the reported GHG emission reductions on the basis set out within the project’s Monitoring Plan indicated in the revised PDD (version 05, dated 29 November 2013) and the applied methodology AMS-I.D (version 13, Grid connected renewable electricity generation), AMS-III.G (version 06, Landfill methane recovery).

KFQ confirms that:

- The project activity has been implemented and operated as per the revised PDD
- The installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately
- The monitoring plan in Monitoring Report is as per the revised PDD
- The monitoring plan in revised PDD is as per the applied methodology,
- The monitoring systems and procedures comply with the monitoring systems and procedures described in the revised approved monitoring plan, and approved methodology including applicable tool(s) and generated GHG emission reductions data
- The GHG emission reductions in the Monitoring Report are calculated without material misstatements

KFQ’s opinion refers to the project’s GHG emissions and resulting GHG emission reductions reported both determined due to the valid and registered project’s baseline, its monitoring plan and its associated documents.

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**VERIFICATION AND CERTIFICATION REPORT**


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Based on the information we have seen and evaluated, we confirm the followings:

Project Title	Mokpo Landfill Gas Recovery Project for Electricity Generation
UNFCCC Reference Number	2834
Date of registration	18 February 2010
Registered PDD	PDD version 04 dated 27 November 2009 (at the time of registration) Approved MP revision dated on 19 January 2011 Revised PDD, version 05 dated 29 November 2013 (Post registration change)
Methodology applied	AMS-I.D (version 13) AMS-III.G (version 06)
Final version of Monitoring Report	MR version 6.0 dated 29 November 2013
Crediting period	18 February 2010 ~ 17 February 2020 (fixed)
Monitoring period	19 August 2012 ~ 18 August 2013
Total GHG emission Reductions Verified	Baseline emissions: 41,688.646 tonnes CO <sub>2</sub> e Project emissions: 1.767 tonnes CO <sub>2</sub> e Leakage: 0 tonnes CO <sub>2</sub> e Emission reductions: <u>41,686 tonnes CO<sub>2</sub>e</u>
GHG emission reductions up to 31 December 2012	<u>13,668 tonnes CO<sub>2</sub>e</u>
GHG emission reductions from 1 January 2013 onwards	<u>28,018 tonnes CO<sub>2</sub>e</u>

**Signed on behalf of the Korean Foundation for Quality**

Signature : 

Name : Yu Shim Jeong

Date : 6 December 2013

## 5 REFERENCES

Reference No.	Documentation and/or website	Remarks
1	<ul style="list-style-type: none"> <li>- Project Design Document of “Mokpo Landfill Gas Recovery Project for Electricity Generation”(UNFCCC Reference No. : 2834), version 02, 23 August 2012</li> <li>- Revised Monitoring Plan (approved 19th January 2011)</li> <li>- Revised PDD (version 05, dated 29 November 2013)</li> </ul>	PDD and MP
2	<ul style="list-style-type: none"> <li>- Final Validation Report, Environmental Management Corporation, Report No. 08-001 (Revision No. 08, 17th February 2010)</li> <li>- Validation report of revised monitoring plan , Korean Foundation for Quality, (Report No. 2010-09, Version NO. 01)</li> <li>- Final Verification report and certification report for 1st monitoring period, Korean Foundation for Quality, (Report No. 2011-03, Version No. 02.3)</li> <li>- Final verification report and certification report for 2nd monitoring period, Korean Foundation for Quality, (Report No. 2011-30, Version No. 01.2)</li> <li>- Final verification report and certification report for 3rd monitoring period, Korean Foundation for Quality, (Report No. 2012-123, Version No. 01.1)</li> <li>- Final validation opinion for post registration change, Korean Foundation for Quality, (Report No. 2013-09, Version No. 01.1)</li> </ul>	Report of validation and verification
3	<ul style="list-style-type: none"> <li>- EB 36, AMS-I.D : Grid connected renewable electricity generation (version 13)</li> <li>- EB 38, AMS-III.G : Landfill methane recovery (version 6.0)</li> <li>- EB 70 annex 2, Clean Development Mechanism Project Standard (version 02.1)</li> <li>- EB 70 annex 3, Clean Development Mechanism Validation and Verification Standard (version 04.0)</li> <li>- EB 70 annex 11, Guidelines for completing the monitoring report form (version 03.1)</li> <li>- EB 74 annex 11, Clean Development Mechanism Project Cycle Procedure (version 04.0)</li> </ul>	Methodology and guidelines
4	<ul style="list-style-type: none"> <li>- Monitoring Report (version 1, 5 August 2013) – for GSC</li> <li>- Monitoring Report (Version 2, 20 August 2013) – Provided on site</li> <li>- Monitoring Report (version 06, 29 November 2013) – final</li> <li>- Spreadsheet of ‘Mokpo_4th MR_R2834_Emission Reduction’ (version 1, 5 August 2013)</li> <li>- Spreadsheet of ‘Mokpo_4th MR_R2834_Emission Reduction’ (version 6.0, 29 November 2013)</li> <li>- Raw data sheet of ‘LFG flow rates &amp; CH<sub>4</sub> fraction (Mokpo LFG plant)’</li> </ul>	Monitoring Report
5	<ul style="list-style-type: none"> <li>- Equipment installation history record by PP (last updated on July 2013)</li> <li>- Permission of electricity generation business, Ministry of Knowledge Economy, last updated on 23 September 2011</li> <li>- Approval letter for grid connection of the project activity, KPX(1<sup>st</sup> :5 September 2008, 2<sup>nd</sup>: 22 May 2009)</li> <li>- Power Generating Equipment Record for 1<sup>st</sup> generator, 2<sup>nd</sup> generator by KESCO</li> <li>- Notification of commercial operation start to local government (Jellanam-do), 18 June 2009</li> <li>- Construction completion confirmation document to Samho Development Co., LTD, 10 October 2012</li> </ul>	Evidence for Project implementation

## Appendix A. Verification Protocol

6	<ul style="list-style-type: none"> <li>- Operating Manual – Mokpo LFG Power Plant-Monitoring (Version: 11), 01 December 2011</li> <li>- Operating Manual – Mokpo LFG Power Plant-Monitoring (Version: 14), 1 October 2013</li> </ul>	Operating Manual
7	<ul style="list-style-type: none"> <li>- A study on the Uncertainty Analysis of First Order Decay Model for Landfill Gas, Vol. 27 No. 8, Korea Society of Waste Management, Seung-Kyu Chun</li> <li>- Waste generation report and management status , 2008~2013 (generation of 2007 ~ 2012), Ministry of environment, Republic of Korea</li> <li>- Monthly waste report, 2013 1~8, Mokpo Landfill Site</li> </ul>	Related evidence for the reason of difference between estimation ER and monitoring result
8	<ul style="list-style-type: none"> <li>- Official Document to explain that power generator's efficiency can be variety from various situation, 18th April 2011, RNP Enterprise Ltd.</li> </ul>	Evidence related LFG amount
9	<ul style="list-style-type: none"> <li>- Manual for Gas analyzer, Fuji instrument Korea</li> <li>- Purchase records of Standard Gases using for Gas analyzer Zero/Span test during monitoring period</li> <li>- Reports of Standard Gases Analysis using for Gas analyzer Zero/Span test during monitoring period</li> </ul>	Zero/Span test
10	<ul style="list-style-type: none"> <li>- Daily, Monthly exported electricity record (from KPX website)</li> <li>- Bills of electricity imported during monitoring period, KEPCO (Korea Electric Power Corporation)</li> </ul>	Data source
11	<ul style="list-style-type: none"> <li>- Official Document on new watt-hour meter, 14 March 2013, New Renewable Energy Center</li> <li>- Official Document to explain the reason for new watt-hour meter installation, 28 August 2013, KPX Law No. 10445, Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy”, amended on 30 July 2013, effective as of 31 October 2013</li> </ul>	Evidence related installation of Wc
12	<ul style="list-style-type: none"> <li>- Official document to show the lowest CH4 concentration required to operate gas engine/generator (40%), 5 September 2012, RNP Enterprise Ltd.</li> </ul>	Data check during event
13	<ul style="list-style-type: none"> <li>- Initial test report for flow meters (for Fa : 24 July 2009, for Fb: 18 March 2009, for Fc: 24 July 2009), Flow technology Co., Ltd.</li> <li>- Second test report for the three flow meters (2~ 3 April 2012), Flow Technology Co., Ltd.</li> <li>- Initial test report for gas analyzer (09 April 2009), Fuji Electric Instrumentation Co., Ltd.</li> <li>- Second test report the gas analyzer (2 April 2012), 6 April 2012, National Metrology Institute</li> <li>- Initial test report for meter of electricity exported (Wa) (28 August 2008), Meter and Petrochemical testing and research Institute</li> <li>- Second test report for meter of electricity exported (Wa) (25 August 2010), Korea Testing Certification</li> <li>- Third test report for meter of electricity exported (Wa) (23 August 2012), Korea Testing Certification</li> <li>- Initial test report for meter of electricity exported (Wc) (9 January 2013), Korea Testing Certification</li> <li>- Initial test report for meter of electricity imported (22 August 2008), LG industrial systems Co., Ltd</li> <li>- Second test report for meter of electricity imported (26 September 2011), Korea Testing Certification</li> </ul>	Measuring equipment calibration report
14	<ul style="list-style-type: none"> <li>- Training plan and records during monitoring plan</li> <li>: Internal training for CDM monitoring, 16 May 2013</li> <li>: External training on risk analysis, 20 June 2013, KOSHA</li> </ul>	Training

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15	- Internal Audit Report, 1 August 2013	Internal Audit
16	- Daily work log (operation)	Data
17	- 2012 landfill gas (LFG) facilities operation status, 2013, Ministry of environment, Republic of Korea	LFG status
18	- E-mail from UNFCCC secretariat on requesting change in monitoring period end date on UNFCCC website	Monitoring period

## Appendix A. Periodic Verification Protocol

**Table 1. Requirement Checklist**

Expectations for GHG data management system/controls	Ref.	Verification Comments	Draft. Concl.	Final Concl.
<b>1. Compliance of the monitoring report with the guidance for completing the monitoring report form</b>				
<b>1.1</b> Does PP submit a fully completed CDM monitoring report?(Should not be blank section)  In case of bundled CDM project activity, separate monitoring reports must be prepared if the bundle includes project activities with: (a) the same type, same category and different technology /measure (b) same type, different categories and technologies /measures (c) different types	Annex 11 of EB70	PP had submitted the monitoring report ver. 1 (dated 5 August 2013) to DOE and the report applied the format decided at the EB 70 meeting (Annex 11).  This project activity is not a bundled project.	<b>OK</b>	<b>OK</b>
<b>1.2 Description of the project activity</b> <b>1.2.1 Purpose and general description</b> given in section B.1 below in terms of <ul style="list-style-type: none"> <li>• Purpose of the project activity and the measures taken to reduce greenhouse gas emissions</li> <li>• Brief description of the installed technology and equipments</li> <li>• Relevant dates for the project activity (e.g. construction, commissioning, continued operation records etc)</li> <li>• Total emission reductions achieved in this monitoring period</li> </ul>	Annex 11 of EB70	Yes. The description of the project activity is properly presented in the section A.1 of the MR. (The project is not a bundled project).  However, the monitoring period of the MR published in the UNFCCC website is 19/08/2012~18/05/2013. And the monitoring period of the revised MR (version 2, dated on 20/08/2013) is 19/08/2012~18/08/2013. Please explain why the monitoring period has been changed.	<b>CAR 5</b>	<b>OK</b>
<b>1.2.2 Location of project activity</b> Is complete information of the location of the project activity : town, city, country and GPS coordinates ?	Annex 11 of EB70	GPS coordinates in the MR and PDD are not consistent with the physical location of the project.	<b>CL 3</b>	<b>OK</b>



## Appendix A. Verification Protocol

<b>1.2.3 Parties and Project participant(s)</b> Are project participants listed?	Annex 11 of EB70	Yes. The project participants are listed in A.3. of the MR.  Two project participants are involved: - Hanwha Corporation, Republic of Korea (host country) - Hanwha Corporation, Switzerland  The participants are listed in the UNFCCC website.	<b>OK</b>	<b>OK</b>
<b>1.2.4 Reference of applied methodology</b> (a) Was the exact reference (number, title, version) of the methodology applied to the project activity indicated? Whenever is applicable included? (b) Was tools and other methodologies to which applied methodology(ies) refers indicated ?	Annex 11 of EB70	Yes. Two methodologies are applied to the project activity and the complete reference of the methodology applied is included in A.4. of the MR as follows.  AMS-I.D.: Grid connected renewable electricity generation (version 13)	<b>OK</b>	<b>OK</b>
<b>1.2.5 Crediting period of project activity</b> Were the type, start date and length of the crediting period corresponding to this monitoring period provided?	Annex 11 of EB70	Yes. The crediting period of the project activity is 10 years fixed and the crediting period is from 18 February 2010 to 17 February 2020 described in A.5 of the MR, which is consistent with the registration information as follows. <a href="http://cdm.unfccc.int/Projects/DB/emc1249265030.9/view">http://cdm.unfccc.int/Projects/DB/emc1249265030.9/view</a>	<b>OK</b>	<b>OK</b>
<b>1.3 Implementation of the project activity</b> <b>1.3.1 Description of implemented registered project activity</b> Does this section include a description of the implementation and operational status of the projects during this monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity?	Annex 11 of EB70, VVS 228	Yes. The overall implementation status of the project and the operational status as of the monitoring period are described in B.1 of the MR in accordance with the CDM Validation and Verification Standard (ver.04.0).	<b>OK</b>	<b>OK</b>
Does the description also include inter alia (a) The starting date of operation of the project activity? For project activities that consist of more than one site, the report shall clearly describe the status of implementation and starting date of operation for each site. For CDM project activities with phased implementation, the report shall indicate the progress of the proposed CDM project activity achieved in each phase. If the phased implementation is delayed, the reasons and expected implementation shall be		(a) 1.065MW generator (generator 1) started commercial operation in September 2008 and 1.058MW generator (generator 2) in June 2009, which are clearly described in B.1 of the MR.  (b) The operation events during the monitoring period are included in the B.1 of the MR, including maintenance, black out, error in transmission, etc.  However,  1. Some operation events are not consistent with operation log.	<b>CL 1</b>	<b>OK</b>

## Appendix A. Verification Protocol

<p>described.</p> <p>(b) The information regarding the actual operation of the project activity during this monitoring period, including information on special events, for example overhaul times, downtime of equipment, exchange of equipment, etc?</p> <p>(c) A brief description of : (i) events or situations that occurred during the monitoring period, which may impact the applicability of the methodology, and (ii) how the issues resulting from these events or situations are being addressed?</p>		<p>(e.g. 19/04/2013~25/04/2013)</p> <p>2. Some maintenance of power plants events is not specified. (e.g. 05/10/2012)</p> <p>3. The data on 08/07/2013 is normal but it is recorded as operation event.</p> <p>(c) No such event occurred during the monitoring period, which may impact the applicability of the methodology.</p>		
<b>1.3.2 Post registration changes</b>				
<p><b>1.3.2.1 Temporary deviations from registered monitoring plan or applied methodology</b></p> <p>Is it indicated whether any temporary deviations have been applied during this monitoring period.</p> <p>In cases, followings are described?</p> <ul style="list-style-type: none"> <li>• Description of the deviation(s) in accordance with applicable provisions for temporary deviations from the registered monitoring plan or applied methodologies in the project activity.</li> <li>• Reason form deviation(s)</li> <li>• How it deviates from the monitoring plan and/or methodology(ies)</li> <li>• The duration for which the deviation(s) is applicable</li> <li>• Justification on the conservativeness of the approach</li> <li>• Approval date, reference number</li> </ul>	Annex 11 of EB70	N/A	OK	OK
<p><b>1.3.2.2 Corrections</b></p> <p>Is it indicated any corrections to project information or parameters fixed at validation.</p> <p>In cases, followings are described?</p> <ul style="list-style-type: none"> <li>• Description of the corrections</li> <li>• Approval date and Reference number</li> <li>• Version number and completion date of the revised PDD</li> </ul>	Annex 11 of EB70	GPS coordinates in the PDD and MR are not consistent with the physical location of the project.	CL 3	OK
<p><b>1.3.2.3 Permanent changes from registered monitoring plan or applied methodology</b></p> <p>Is it indicated any permanent changes from the registered</p>	Annex 11 of EB70	New Watt-hour meter was installed during 4 <sup>th</sup> monitoring period. Please explain how exported electricity is measured by KPX.	CAR 4	OK

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<p>monitoring plan or applied methodologies. In cases, followings are described?</p> <ul style="list-style-type: none"> <li>• Description of the changes</li> <li>• Approval date and reference number</li> <li>• Version number and the completion date of the revised PDD.</li> </ul>				
<p><b>1.3.2.4 Changes to project design of registered project activity</b> Is it indicated any changes to the project design of the project activity. In cases, followings are described?</p> <ul style="list-style-type: none"> <li>• Description of the changes</li> <li>• Approval date and reference number</li> <li>• Version number and the completion date of the revised PDD.</li> </ul>	Annex 11 of EB70	N/A	<b>OK</b>	<b>OK</b>
<p><b>1.3.2.5 Changes to start date of crediting period</b> Is it indicated any changes to the start date of the crediting period. In cases, followings are described?</p> <ul style="list-style-type: none"> <li>• Description of the changes</li> <li>• Approval date and reference number</li> </ul>	Annex 11 of EB70	N/A	<b>OK</b>	<b>OK</b>
<p><b>1.4 Description of the monitoring system</b> 1.4.1 Is a description of the monitoring system provided?</p>	Annex 11 of EB70	Yes.	<b>OK</b>	<b>OK</b>
<p>1.4.2 Does this section include data collection procedures (information flow including data generation, aggregation, recording, calculation and reporting), organizational structure, roles and responsibilities of personnel, and emergency procedures for the monitoring points?</p>		Yes. Yes. Data collection procedures (LFG flow, CH <sub>4</sub> fraction of LFG, electricity exported & imported, calibration of meters), data management, organizational structure, roles and responsibilities, emergency procedures are included in C. of the MR.	<b>OK</b>	<b>OK</b>
<p>1.4.3 Does this include line diagrams showing all relevant monitoring points?</p>		New Watt-hour meter was installed during 4 <sup>th</sup> monitoring period. Please explain how exported electricity is measured by KPX.	<b>CAR 4</b>	<b>OK</b>
<p><b>1.5 Data and parameters</b> (a) Does this section include parameters used to calculate baseline, project, and leakage emissions as well as other relevant parameters required by the approved methodology and the monitoring plan; and specific information on how data and parameters have been</p>	Annex 11 of EB70	Yes. The parameters used to calculate baseline, project and leakage emissions as well as other relevant parameters required by the approved methodology and the monitoring plan are included in section D. of the MR.	<b>OK</b>	<b>OK</b>

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monitored during the monitoring period?				
(b) Are data that is determined only once for the crediting period but are used after registration of the project activity included here under section D.1?		Yes. Data and parameters determined at registration and not monitored during the monitoring period, is included in section D.1. (including CO <sub>2</sub> Emission Intensity of the Electricity displaced).	<b>OK</b>	<b>OK</b>
(c) For each parameter the following information, using the tables provided, is provided:		Yes. The following information is provided for each parameter using the table provided in the Guidelines for completing the monitoring report form (ver. 03.1).  Please refer to 1.5 (d)~ (j) as below.	<b>OK</b>	<b>OK</b>
(d) Values of monitored parameter in the period for the purpose of calculating emission reductions? To report multiple values, a table may be used and included in this monitoring report or include references to spreadsheet. For default value (such as an IPCC value), where it is ex-post confirmed, the most recent value shall be applied.		The values of monitored parameter in the period for the purpose of calculating ER are provided in section D.2 of the MR using the table.  However, GWP <sub>CH4</sub> applied for 2013 ex-ante parameter is not in line with EB decision.	<b>CAR 3</b>	<b>OK</b>
(e) Description of the equipment used to monitor each parameter, including details on accuracy class, and calibration information (frequency, date of calibration and validity), if applicable as per monitoring plan?		Yes. Description of the monitoring equipment used to monitor each parameter is provided using the table.	<b>OK</b>	<b>OK</b>
(f) Measuring and recording method: how the parameters are measured/calculated, specifying the measurement and recording frequency?		The measuring and recording methods are correctly indicated in section D.2. of the MR using the table.	<b>OK</b>	<b>OK</b>
(g) Source of data: logbooks, daily records, surveys, etc?		Yes. The sources of data for the parameters are indicated in section D.2 of the MR using the table.	<b>OK</b>	<b>OK</b>
(h) Where relevant, the calculation method of the parameter?		Yes. The calculation methods for the parameters are provided in section D.2 of the MR using the table.	<b>OK</b>	<b>OK</b>
(i) The QA/QC procedures applied (if applicable per monitoring plan)?		Yes. The QA/QC procedures applied are provided in section D.2 of the MR using the table.	<b>OK</b>	<b>OK</b>
(j) Include information about appropriate emission factors, IPCC default values and any other reference values that have been used in the calculation of emission reductions?		Yes. The information on the reference values used in the calculation of ER is included in section D.1 and D.2. of the MR (including GWP <sub>CH4</sub> for the 1 <sup>st</sup> and 2 <sup>nd</sup> commitment period).	<b>OK</b>	<b>OK</b>

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<b>1.6 Implementation of sampling plan</b> <i>If applicable, check the completeness in accordance with D.3</i>	Annex 11 of EB70	N/A	OK	OK
<b>1.7 Calculation of emission reductions</b>				
<b>1.7.1 Calculation of baseline emissions</b> 1.7.1.1 Does this section include sample calculations for all formulae used and calculation of BE applying actual values.	Annex 11 of EB70	Yes. All formulae used and description to calculate the BE applying actual value are included in section E.1 of the MR.	OK	OK
1.7.1.2 Was a table used in this monitoring report if applicable and referenced to attached electronic spreadsheets to present full calculations in the monitoring report?		Yes. The calculation is described in section E.1 of MR and spreadsheet is included as references.	OK	OK
<b>1.7.2 Calculation of project emissions</b> 1.7.2.1 Does this section include all formulae used and description to calculate the project emissions applying actual values?	Annex 11 of EB70	Yes. All formulae used and description to calculate the project emissions are included in E.2 of the MR.	OK	OK
1.7.2.2 Was a table used and included in this monitoring report or include references to spreadsheet?		Yes.	OK	OK
<b>1.7.3 Leakage calculation</b> 1.7.3.1 Does this section include all formulae used and description to calculate the leakage applying actual values?	Annex 11 of EB70	N/A This project activity has no leakage.	OK	OK
1.7.3.2 Was a table used and included in this monitoring report or include references to spreadsheet?		N/A	OK	OK
<b>1.7.4 Emission reductions calculation/table</b> Does this section include the formulae used to calculate the emission reductions and the total of the emission reductions achieved during the monitoring period? a. Total baseline emissions b. Total project emissions c. Total leakage d. Total emission reductions	Annex 11 of EB70	Yes. The formulae used to calculate the ER and the total of ER achieved during the monitoring period are included in section E.1~E.4 of the MR and all achieved values are indicated.	OK	OK

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<b>1.7.5 Comparison of actual emission reductions with estimate in the CDM-PDD</b> Does this section include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD?	Annex 11 of EB70	Yes. A comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD is included in E.5. of the MR.	<b>OK</b>	<b>OK</b>
<b>1.7.6 Remarks on difference from estimated value in the PDD</b> Is the explanation of the cause of any increase in the actual emission reductions achieved during the current monitoring period (e.g. higher water availability, higher load plant factor, etc.), including all information (i.e. data and/or parameters) that is different from that stated in the registered CDM-PDD provided?	Annex 11 of EB70	Yes. The explanation on difference from estimated value in the PDD was conducted in section E.6 of the MR.	<b>OK</b>	<b>OK</b>
<b>2. Project activity implementation</b>				
2.1 Actual project activity and its operation conforms with the registered PDD.	VVS 226	<p>Mokpo Landfill which is located in Daeyang-dong Mokpo-city Jeollanam-do and the total land area is 290,490 m<sup>2</sup> and waste disposal area is 180,000 m<sup>2</sup>. This project involves the installation of a highly efficient collecting, transmitting and pre-treatment system and two electricity generators. The two generators installed with total capacity of 2.123 MW (1.065 MW and 1.058 MW).</p> <p>This project activity has been implemented as two phase. Firstly, 1.065 MW generator was installed in September 2008 and additional 1.058 MW generator was installed in April 2009. The commercial operation of the project started in June 2009.</p> <p>The project was registered on 18 February 2010. The crediting period is from 18 February 2010 to 17 February 2020. This is the fourth monitoring period under verification. The start date of this monitoring period is 19 August 2012, which is the next day of third monitoring period's end date. The end date of this monitoring period is 18 August 2013 which is within the crediting period.</p> <p>These dates were verified through documented evidence during on-site visit. The project activity was implemented and operated according to the revised PDD and the monitoring plan.</p>	<b>OK</b>	<b>OK</b>

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2.2 Are all physical features of this project activity, proposed in the registered PDD, in Place?	VVS 226	<p>Yes. All physical features of this project activity are in place in accordance with the stipulated information on the revised PDD.</p> <p><b><u>Specification of LFG collection system, pre-treatment, engine, and generator</u></b></p> <p>There are LFG collection system, Landfill gas pre-treatment system, and Electricity generation system in the site.</p> <p>In LFG collection system, the number of vertical well is not consistent with that of PDD. The vertical well number in PDD is 121 but installed vertical well number in this monitoring period is 149. (There are 13 wellheads on the project site and each well head had been connected to the 12 vertical wells. For efficient management of landfill, repair work has been conducted in October 2012 and less efficient 7 wells had been removed.)</p>	OK	OK
2.3 Have the project participants operated the CDM project activity as per the registered PDD?	VVS 226/ 227	Yes, project participant have operated the CDM project activity as per the revised PDD. The verification team checked its implementation during the on-site visit.	OK	OK
2.4 Is the project implementation in accordance with the provisions of the registered PDD and/or and approved revised PDD	VVS 230	Yes. The project activity has been implemented in accordance with the revised PDD.	OK	OK
2.5 Was an on-site visit conducted?	VVS 226	<p>Yes. On-site assessment was conducted on 20 August 2013. The audit purpose and methodology was briefed in the opening meeting participated by the following persons:</p> <p><b><u>Korean Foundation for Quality</u></b></p> <ul style="list-style-type: none"> <li>- Eun Jung KIM (audit team leader, auditor)</li> <li>- Jin Seok CHO (audit team member, auditor)</li> </ul> <p><b><u>Hanwha Corporation (Project owner)</u></b></p> <ul style="list-style-type: none"> <li>- Kun Hong LEE</li> <li>- JIN Young CHOI</li> </ul> <p><b><u>Econetwork Co., Ltd. (Consulting company)</u></b></p> <ul style="list-style-type: none"> <li>- Seon Young MOON</li> <li>- Yeah Won KIM</li> </ul>	OK	OK
2.6 If not, justify the rationale of the decision.	VVS 226/ 227	N/A	OK	OK

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2.7 Was there any deviation or the proposed or actual changes in the implementation or operation of the project activity complying with the requirements of the Project Standard? Otherwise assess it in accordance with 270~282 of VVS and request for approval of the change by EB.	VVS 226, 269	New Watt-hour meter was installed during 4 <sup>th</sup> monitoring period. Please explain how exported electricity is measured by KPX.	<b>CAR 4</b>	<b>OK</b>
2.8 Is there any corrections to project information or parameters fixed at validation as described in the registered PDD, made by project participants in a revised PDD. If so, assess it in accordance 257~259.	VVS 257~2 59	In this monitoring period, post-registration change has been requested and the verification report is based on the revised PDD (version 05, dated on 29 November 2013).	<b>CAR 4 CL 3</b>	<b>OK</b>
<b>3. Compliance of the monitoring plan with the monitoring methodology and applicable tool(s)</b>				
3.1 Is the validated monitoring plan in accordance with the approved methodology applied by the CDM project activity?	VVS 229, 232	Yes. The applied monitoring plan complies with the approved methodology, AMS-I.D (ver. 13) and AMS-III.G (ver. 06).	<b>OK</b>	<b>OK</b>
3.2. If no, was a request for revision to or deviation of the monitoring plan was done? (The DOE may request for revision of the monitoring plan covering the monitoring period under verification, for approval by the Board), or applied the provisions of the Project Standard. In cases, assess it in accordance with 252~256 and 263~268 of VVS.	VVS 251, 252, 262, 263, 265	N/A	<b>OK</b>	<b>OK</b>
3.3 Are there any monitoring aspects of the project activity that are not specified in the methodology, particularly in the case of small-scale methodologies (e.g. additional monitoring parameters, monitoring frequency and calibration frequency)?	VVS 229, 230	N/A	<b>OK</b>	<b>OK</b>
3.4 Are there any monitoring aspects relating to applicability conditions of the methodology? If so, are these conditions still met.	VVS 229, 230	N/A	<b>OK</b>	<b>OK</b>
<b>4. Compliance of monitoring with the monitoring plan</b>				



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4.1 Monitoring of reductions in GHG emissions to result from the project activity shall be implemented in accordance with the monitoring plan contained in the registered PDD or the accepted revised monitoring plan.	VVS 233	New Watt-hour meter was installed during 4 <sup>th</sup> monitoring period. Please explain how exported electricity is measured by KPX.	<b>CAR 4</b>	<b>OK</b>
4.2 Was a request for revision to or deviation of the monitoring plan was done? (The DOE may request for revision of the monitoring plan covering the monitoring period under verification, for approval by the Board), or applied the provisions of the Project Standard. In cases, assess it in accordance with 252~256 and 263~268 of VVS.	VVS 251, 252, 262,26 3,265	Please refer to 4.1.	<b>CAR 4</b>	<b>OK</b>
4.3 Has the monitoring plan been properly implemented and followed by the project participants?	VVS 234(a)	Please refer to 4.1.	<b>CAR 4</b>	<b>OK</b>
4.4 Have all parameters stated in the monitoring plan, the applied methodology and relevant decisions been sufficiently monitored and updated as applicable, including?	VVS 234(b)	All parameters in the revised monitoring plan stated in the monitoring report.	<b>OK</b>	<b>OK</b>
4.4.1 Project emission parameters?	VVS 234(b)	According to the revised monitoring plan, only power use to operate the LFG capture and utilization facility is considered to be project emission. Hence, the project emission parameter is imported electricity ( $EL_{IMP,PJT,y}$ ).  To monitor imported electricity, one (1) watt-hour meter is installed (tag : $W_b$ ). The amount of imported electricity are measured automatically by certified watt-hour meter and got from the bill issued by KEPCO.  However, the imported electricity data during 19/07/2013~18/08/2013 is not provided. Please provide the data with relevant evidence and reflect in the excel spreadsheet as well the MR.	<b>CAR 2</b>	<b>OK</b>
4.4.2 Baseline emission parameters?	VVS 234(b)	Major parameters for baseline were $LFG_{electricity,y}$ , $W_{CH4,y}$ , $EL_{EXP,PJT,y}$ . These were consistent with the revised monitoring plan.  The description of meters for parameters are as below;	<b>OK</b> <b>CAR 1</b> <b>CAR 4</b>	<b>OK</b>

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		<p><u>LFG flow meters for <math>LFG_{electricity,y}</math></u>  Three flow meters were installed for measuring amount of LFG combusted in power plant (<math>LFG_{electricity,y}</math>). Two flow meters (Tag : <math>F_b</math>, (for generator 1), <math>F_c</math> (for generator 2)) were located in front of each power generation and used for direct measuring the amount of LFG combusted in power plant (<math>LFG_{electricity,y}</math>). Total amount of landfill gas combusted in power plant is the sum of value measured from <math>F_b</math>, and <math>F_c</math>. Thus, <math>LFG_{electricity,y}</math> was monitored with <math>F_b</math> and <math>F_c</math> and <math>LFG_{electricity,y}</math> in the spread sheet of 'Mokpo_4th MR_R2834_Emission Reduction' have been verified against the data from centralized monitoring system during the on-site visit. And the other flow meter (Tag : <math>F_a</math> (total flow meter)) was located in front of the branch of pipeline to each power generator and the measured value from <math>F_a</math> was used for cross check. Amount of landfill gas combusted in power plant is measured by gas flow meters and the data is got from centralized monitoring system data server.</p> <p><u>Gas analyzer for <math>W_{CH_4,y}</math></u>  For monitoring methane fraction, gas analyzer (Tag: g) is installed. Methane fraction in LFG is measured by a methane analyzer and the data is got from centralized monitoring system data server. <b>[CAR 1]</b></p> <p><u>Watt-hour meter for <math>EL_{EXP,PJT,y}</math></u>  The amount of exported electricity is measured automatically by two watt-hour meters: <math>W_a</math> is used when generator 1 operates or generator 1 and 2 operate; <math>W_c</math> is used when generator 2 operates. <b>[CAR 4]</b>  The data can be checked from KPX website (E-power market).</p>		
4.4.3 Leakage parameters?	VVS 234(b)	N/A	<b>OK</b>	<b>OK</b>
4.4.4 Regarding the management and operational system, are the responsibilities and authorities for monitoring and reporting in accordance with the responsibilities and authorities stated in the monitoring plan?	VVS 234(b)	<p>The responsibilities and authorities for monitoring and reporting are in accordance with those stated in the monitoring plan.</p> <p>There are included the monitoring team structure and described on the position and function in the monitoring report and operating manual (ver.14) of project entity. There is no contradiction between both documents as well as real situation</p>	<b>OK</b>	<b>OK</b>

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4.5 Is the accuracy of equipment used for monitoring in accordance with section 4. below and is controlled and calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturer’s specification.	VVS 234(c)	<u>Gas flow meters</u> LFG <sub>electricity,y</sub> is measured by gas flow meter. The flow meter is calibrated every three years. The 2 <sup>nd</sup> calibration was performed on 2 April 2012 and performed by Flow Technology Co., Ltd., 3 <sup>rd</sup> party.				
		Applied parameter		LFG <sub>electricity,y</sub>		
		Description		Amount of landfill gas combusted in power plant		
		Type		Thermal mass flow meter		
		Tag		F <sub>a</sub> (Total)	F <sub>b</sub> (1 <sup>st</sup> generator)	F <sub>c</sub> (2 <sup>nd</sup> generator)
		Serial No.		906044B	812003	906044A
		Accuracy level		1%	1%	1%
		Installation date		27-07-2009	27-07-2009	20-05-2009
		Initial test	Testing (Reporting)	24-07-2009 (2009-06-31)	18-03-2009 (2008-12-03)	24-07-2009 (2009-06-31)
			Validity	23-07-2012	17-03-2012	23-07-2012
			Calibration Entity	Flow Technology Co., Ltd.		
		Second test	Testing	02-04-2012 ~ 03-04-2012	02-04-2012 ~ 03-04-2012	02-04-2012 ~ 03-04-2012
			Validity	01-04-2015	01-04-2015	01-04-2015
			Calibration Entity	Flow Technology Co., Ltd.		
		When the flow rate data was transfer to the server, data lag was occurred occasionally. In this case there is no record spot flow rate data but it is possible to measure total flow rate during the time because measuring figure is accumulated data.				
<u>Gas analyzer</u> W <sub>CH4,y</sub> is measured by gas analyzer. The gas analyzer is calibrated every three years and performed by National Metrology Institute, 3 <sup>rd</sup> party as follows.						
Applied parameter		W <sub>CH4,y</sub>				
Description		Methane fraction in LFG				
Type		Methane analyzer				

CAR 4	OK
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		Tag		G			
		Serial No.		A8M7282T			
		Accuracy level		Linearity 1%, Repeatability 0.5%			
		Measurable gas components and measuring range			Minimum range	Maximum range	
				CO <sub>2</sub>	0 ~ 500 ppm	0 ~ 100vol%	
				CH <sub>4</sub>	0 ~ 1,000 ppm	0 ~ 100vol%	
				O <sub>2</sub> (built-in parameter)	0 ~ 5 vol%	0 ~ 100vol%	
		Installation date		02-06-2009			
		Initial Test	Testing	09-04-2009 (K02505)			
			Validity	08-04-2012			
			Calibration Entity	Fuji Electric Instrumentation Co., Ltd. (Initial)			
		Second Test	Testing	02-04-2012 (1201-00302-001)			
			Validity	01-04-2015			
			Calibration Entity	KRISS (National Metrology Institute)			
		When data lag is occurred, it is needed to control data for calculate ER as a conservative manner. When it is occurred, PP selected the lower CH <sub>4</sub> concentration for BE calculation. Verification team checked that this correction logic is applied in the raw data sheet and this approach is a conservative manner to calculate BE.					
		<u>Meters for electricity exported to the Grid</u>					
		EL <sub>EXP,PJT,y</sub> is measured with two watt-hour meters. <b>[CAR 4]</b>					
		The calibration frequency for this meter is 2 years. The verification team confirmed that the following calibration was performed by Korea Testing Certification, 3rd party.					
		Applied parameter		EL <sub>EXP,PJT,y</sub>			
Description		Amount of exported electricity					
Tag		W <sub>a</sub>		W <sub>c</sub>			

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		Serial No.		95246742	50339836																															
		Accuracy level		0.5S	0.5S																															
		Installation date		06/09/2008	27/01/2013																															
		Initial Test	Testing	28-08-2008	04/01/2013																															
			Validity	27-08-2010	03-01-2015																															
			Calibration Entity	Korea Testing Certification	Korea Testing Certification																															
		Second Test	Testing	25-08-2010																																
			Validity	24-08-2012																																
			Calibration Entity	Korea Testing Certification.																																
		Last Test	Testing	23-08-2012																																
			Validity	22-08-2014																																
			Calibration Entity	Korea Testing Certification																																
		<u>Meters for electricity imported from the Grid</u> EL <sub>IMP,PT,Y</sub> is measured with watt-hour meter. The calibration frequency for this meter is 2 years. The verification team confirmed that the calibration was performed by Korea Testing Certification, 3 <sup>rd</sup> party, as follows.																																		
		<table><tr><td colspan="2">Description</td><td>Amount of imported electricity</td></tr><tr><td colspan="2">Applied parameter</td><td>EL<sub>IMP,PT,Y</sub></td></tr><tr><td colspan="2">Tag</td><td>W<sub>b</sub></td></tr><tr><td colspan="2">Serial No.</td><td>0190662</td></tr><tr><td colspan="2">Accuracy level</td><td>1s</td></tr><tr><td colspan="2">Installation date</td><td>01-06-2009</td></tr><tr><td rowspan="3">Initial test</td><td>Testing</td><td>22-08-2008</td></tr><tr><td>Validity</td><td>21-08-2010</td></tr><tr><td>Calibration Entity</td><td>LS industrial Co., Ltd.</td></tr><tr><td rowspan="3">Second test</td><td>Testing</td><td>27-09-2011</td></tr><tr><td>Validity</td><td>26-09-2013</td></tr><tr><td>Calibration Entity</td><td>Korea Testing Certification (KTC)</td></tr></table>					Description		Amount of imported electricity	Applied parameter		EL <sub>IMP,PT,Y</sub>	Tag		W <sub>b</sub>	Serial No.		0190662	Accuracy level		1s	Installation date		01-06-2009	Initial test	Testing	22-08-2008	Validity	21-08-2010	Calibration Entity	LS industrial Co., Ltd.	Second test	Testing	27-09-2011	Validity	26-09-2013
Description		Amount of imported electricity																																		
Applied parameter		EL <sub>IMP,PT,Y</sub>																																		
Tag		W <sub>b</sub>																																		
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	Validity	21-08-2010																																		
	Calibration Entity	LS industrial Co., Ltd.																																		
Second test	Testing	27-09-2011																																		
	Validity	26-09-2013																																		
	Calibration Entity	Korea Testing Certification (KTC)																																		

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4.6 Are monitoring results consistently recorded as per approved frequency?	VVS 234(d)	<p>According to the monitoring plan in the revised PDD, treated LFG flow meter (<math>LFG_{\text{electricity, y}}</math>), <math>CH_4</math> concentration in LFG (<math>W_{CH_4, y}</math>) are automatically measured continuously and recorded in electric file. Electricity exported to the grid by the project (<math>EG_{\text{EXP, PJT}}</math>) and electricity imported from the Grid (<math>EG_{\text{IMP, PJT}}</math>) are measured hourly and recorded monthly which is in compliance with the revised PDD.</p> <p>When the flow rate data was transferred to the server, data lag happened occasionally. In this case there is no spot flow rate data but it is possible to measure total flow rate during the time because measuring equipment is accumulation type.</p>	OK	OK
4.7 Have quality assurance and quality control procedures been applied in accordance with the monitoring plan?	VVS 234(e)	QA/QC procedures for recording, maintaining and archiving of data have been applied in accordance with the monitoring plan and is properly implemented.	OK	OK
<b>5. Compliance with the calibration frequency requirements for measuring instruments</b>				
5.1 Is the calibration of those equipments that have an impact on the claimed emission reductions conducted at a frequency specified in the applied monitoring methodology and/or monitoring plan,	VVS 237, 243	Yes. The calibrations of meters were conducted at a frequency specified in the revised monitoring plan. The verification team confirmed it through test reports of each meter.	OK	OK
5.2 Is there delayed calibration. If so, appropriate measures are taken for data in the relevant period in accordance with 'Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)'	VVS 238, 240	Delayed calibration was not occurred during the monitoring period.	OK	OK
5.3 The verification team shall confirm that the error has been applied (a) In a conservative manner, such that the adjusted measured valued of the delayed calibration shall in fewer claimed emission reductions (b) For all measured values taken during the period between the scheduled date of the calibration and the actual date of calibration.	VVS 239	N/A	OK	OK
5.4 It is not possible for the PPs to conduct calibration at a frequency specified by either the applied methodology, guidance provided by the Board, and/or the registered monitoring plan due to reasons beyond the control of project participants, follow the requirements for post	VVS 241	N/A	OK	OK

## Appendix A. Verification Protocol

registration changes in section of E of the VVS and appendix 1 of the project standard.				
5.5 In cases where neither the monitoring methodology nor the monitoring plan specify any requirements for calibration frequency for measuring equipments, the verification team shall determine whether the equipments are calibrated either in accordance with the specifications of the local/national standards, or as per the manufacturer's specification. If neither local/national standards nor the manufacturer's specification are available, international standards may be used.	VVS 242	Gas flow meter has been calibrated every three years in line with procedure calibration manual from manufacturer. Gas analyzer is subject to regular maintenance and testing regime in accordance with the manufacturer's specification. The gas analyzer has been calibrated every three years. Meters for electricity exported to and imported from the Grid are subject to regular maintenance and testing regime complying with the "Act for measurement" and "Regulation for operation of electricity market" in South Korea. The calibration frequency for these meter is 2 years. Meter for electricity exported to the Grid has been calibrated every 2 years.	<b>OK</b>	<b>OK</b>
<b>6. Assessment of data and calculation of greenhouse gas emission reductions</b>				
6.1 The data and calculations of GHG emission reductions achieved by/resulting from the project activity shall be assessed by application of the selected approved methodology	VVS 244	Yes. GHG emission reductions resulting from the project activity was calculated applying the selected methodology, AMS-III.G ver.6 and AMS-I.D ver.13.	<b>OK</b>	<b>OK</b>

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6.2 Is a complete set of data for the specified monitoring period is available? If no, i.e., only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, the verification team shall either raise a CAR for the PPs to comply with the requirements of appendix 1 of the Project Standard or submit a request for deviation prior to submitting the request for issuance, if appropriate.	VVS 245(a)	<p>A complete set of data for the applied monitoring period has been provided to verification team by PP. In addition to this, the test reports of all relevant meters were submitted as well.</p> <p>Therefore, verification team has confirmed the following evidences provided for the specific monitoring period</p> <ul style="list-style-type: none"> <li>- Flow meters data record</li> <li>- Gas analyzer data record</li> <li>- Daily, monthly exported electricity record from KPX website</li> <li>- Bills for imported electricity issued by KEPCO</li> <li>- Daily work log (operation)</li> <li>- Spread sheet ‘ Mokpo_4th MR_R2834_Emission Reduction’</li> </ul> <p>However, imported electricity data during 19/07/2013~18/08/2013 is not provided. Please provide the data with relevant evidence and reflect in the excel spreadsheet as well the MR.</p>	<b>CAR 2</b>	
6.3 Has information provided in the monitoring report been cross-checked with other sources such as plant log books, inventories, purchase records, laboratory analysis?	VVS 245(b)	<p>The flow meter for generator 1 (Fb) and generator 2 (Fc) and total flow meter (Fa) were installed at the project site. Each flow meter are cross checked with as formula <math>Fa = Fb + Fc</math>. And the daily accumulated flow data crosschecked with Daily record.</p> <p>For confirmation of amount of <math>EG_{EXP, PJT}</math>, the verification team crosschecked with sales receipt of KPX (<a href="http://epsis.kpx.or.kr">http://epsis.kpx.or.kr</a>). Also, imported electricity was crosschecked with the invoice issued by KEPCO.</p>	<b>OK</b>	<b>OK</b>
6.4 Have calculations of baseline emissions, project activity emissions and leakage, as appropriate, been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document?	VVS 245(c)	Yes. The calculations of baseline emissions, project emissions (no leakage) have been carried out in accordance with the formulae and method described in the monitoring plan and the applied methodology, AMS-III.H ver.6 and AMS-I.D ver.13.	<b>OK</b>	<b>OK</b>
6.5 Have any assumptions used in emission calculations been justified?	VVS 245(d)	No assumption was used in the emission calculation for this project activity.	<b>OK</b>	<b>OK</b>



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<p>6.6 Have appropriate emission factors, IPCC default values and other reference values been correctly applied?</p>	<p>VVS 245(e)</p>	<p>According to the revised PDD, PP determined to use ex-ante emission factor (CEF: 0.5375 tCO<sub>2</sub>e/MWh) during the crediting period. Hence, it is correctly applied for emission calculation. And verification team confirmed that f (fraction of methane captured at the SWDS and flared, combusted or used in another manner: 0), GWP<sub>CH<sub>4</sub></sub>(21 tCO<sub>2</sub>e/tCH<sub>4</sub> for the 1st commitment period and 25 tCO<sub>2</sub>e/tCH<sub>4</sub> for the 2<sup>nd</sup> commitment period) are correctly applied during monitoring period through checking related documents and site inspection.</p> <p>For the density of CH<sub>4</sub> under STP (Standard temperature and pressure) the value of 0.0007168 kg/Nm<sup>3</sup> was applied to BE calculation. The source of this value is ACM0001 (ver.11) and the verification team identified the density of CH<sub>4</sub> are correctly applied during monitoring period through checking the ACM0001 (ver.11) and spread sheet of 'Mokpo_4th MR_R2834_Emission Reduction'.</p>	<p><b>OK</b></p>	<p><b>OK</b></p>
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**Table 2. GHG data management system/controls**

<b>GHG data management system/controls</b>	<b>Score</b>	<b>Verification Comments</b>	<b>Remarks</b>
<b>1. Define organizational structure, responsibilities and competencies</b>			
<b>1.1 Position and roles</b> Position and role of each person in the GHG data management process is clearly defined and implemented, from raw data generation to submission of the final data.	Full	PP indicates position and role in section 2 of “Operating Manual-Mokpo LFG Power Plant” (ver 14. dated 01/10/2013). The verification team interviewed staffs at the project site and confirmed that CDM monitoring is implemented as per the manual.  - CDM team director in headquarter : overall authority and responsibility of data monitoring/record, monitoring report - Person in charge of CDM in HQ : Supporting and supervising for operation and maintenance of CDM project. Staff training and compile of monitoring report - Site manager: Management of operation and maintenance of the project activity. Data report to HQ - Site staff : Data management(collection and control) and keep, Operating equipment on the site	<b>OK</b>
<b>1.2 Responsibilities</b> Specific monitoring and reporting tasks and responsibilities are included in job descriptions or special instructions for employees.	Full	Overall responsibility for operation, maintain of facilities, monitoring and reporting of the project is charged by CDM team manager in headquarter and it is well indicated in “Operating Manual-Mokpo LFG Power Plant”. And Specific tasks are also well described in the manual.	<b>OK</b>
<b>1.3 Competencies needed</b> Competencies needed for each aspect of the GHG determination process are analyzed. Personnel competencies are assessed and training programme implemented as required,	Full	To meet competency needed for GHG determination process, CDM monitoring training was conducted toward those person who involved in the GHG determination process  - Internal training for monitoring on 16 May 2013 : Introduction on GHG Emission Trading : The requirement for CDM  Through interviewing with those personnel who attended in the training, the verification team checked that staffs know where those collected data are used and that accuracy should be ensured.	<b>OK</b>

<b>2. GHG data management system and controls</b>			
<b>2.1 Information/process flow</b> An information/process flow diagram, describing the entire process from raw data to reported totals is developed.	Full	<p>According to the operating manual, flow meter and gas analyze data are measured and recorded continuously in electric file on daily basis and exported and imported electricity data are measured hourly and recorded on a monthly basis. The entire procedures to processing the data are clearly indicated “Operating Manual-Mokpo LFG Power Plant” and it is consistent with monitoring plan in the revised PDD.</p> <p>However, monitoring of <math>EL_{EXP,PJT,y}</math> was not implemented as per the monitoring manual.</p>	<b>CL 4</b>
<b>2.2 Data transfer</b> Where data is transferred between of within systems/spreadsheets, the method of transfer (automatic/manual) is highlighted-automatic links/updates are implemented where possible. All assumptions and the references to original data sources are documented.	Full	<p>The data for flow meter, gas analyzer are automatically gathered and transferred to the data server in the site office (centralized monitoring system). The data for exported electricity data is automatically measured and transferred to Korea Power Exchange. The consumed electricity data is gathered and processed with monthly paper bill from KEPCO.</p>	<b>OK</b>
<b>2.3 Data trails</b> Requirements for documented data trails are defined and implemented and all documentation are physically available.	Full	<p>According to the data management procedure in “Operating Manual-Mokpo LFG Power Plant”, the all relevant documents to be monitored are managed in the facility. Documents related to electricity transmission data, sales/purchase (bills), and testing or calibration reports are also filing by site staff and it kept in site office. And it is planned in the operating manual and the revised monitoring plan to keep the data and related documents until two years after the end of the crediting period.</p> <p>Verification team checked that all relevant documents mentioned above including data records have been kept. Thus, verification team believes relevant documents will be kept until two years after the end of the crediting period as per the operating manual.</p>	<b>OK</b>
<b>2.4 Guidance on checks and reviews</b> Guidance is provided on when, where and how checks and reviews are to be carried out, and what evidence needs to be documented. This includes spot checks by a second person not performing the calculations over manual data transfers, changes in assumptions and the overall reliability of the calculation processes.	Full	<p>According to “Operating Manual-Mokpo LFG Power Plant”, CDM team manager in headquarter (Hanwha corporation) has responsibility for the management and supervision of the entire CDM project activity. And the site manager has assisted the CDM team regarding CDM monitoring plan.</p> <p>Consequently, CDM team manager in headquarter has responsibility to update the monitoring plan and manual when the monitoring system needs to be changed.</p> <p>The verification team confirms that CDM monitoring system has been implemented as per the monitoring manual through checking related documents and interviewing staffs.</p>	<b>OK</b>

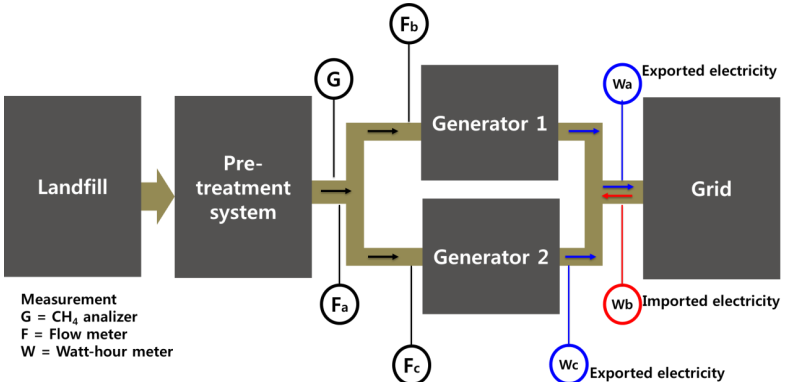
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<p><b>2.5 Internal verification</b> Internal verifications include the GHG data management systems, to ensure consistent application of calculation methods.</p>	Full	Data gathering, emission reduction calculation, and compilation of monitoring report is prepared by the person in charge of CDM in headquarter, who has competency through relevant trainings. Thus, it is believed calculation methods can be applied consistently.	<b>OK</b>
<p><b>2.6 Internal validation</b> Data reported from internal departments should be validated visibly (by signature or electronically) by an employee who is able to assess the accuracy and completeness of the data.</p>	Full	According to section 8 of “Operating Manual-Mokpo LFG Power Plant”, weekly measured data is reported to the person in charge of CDM in headquarter; internal audit for management of monitoring data is annually carried out by internal auditor who is appointed by person in charge of CDM in headquarter; internal auditor is appointed as person who is able to assess the accuracy and completeness of the data. The result of internal audit is reported to CDM manager. The verification team checked the internal audit report conducted on 1 August 2013.	<b>OK</b>
<p><b>2.7 Data protection measures</b> Data protection measures for databases/spreadsheets should be in place (access restrictions and editor rights).</p>	Full	LFG flow rate and gas analyzer data are stored on data server with continuous backup. Complementarily, the daily manual report recorded daily LFG flow (Nm <sup>3</sup> /h), CH <sub>4</sub> content (%) and Gas analyzer zero/span test report are stored at site office. Electricity supplying to the Grid is aggregated from the KPX system which is only readable. Electricity consumption is also based on the bills from KEPCO thus PP cannot amend any of data. PP can only read the figures from two data source. Emission reduction calculation sheet was just developed for this monitoring period and it was well organized and used by PP properly.	<b>OK</b>

**Table 3. Resolution of Corrective Action, Clarification Requests and Forward Action Requests**

Draft report clarifications and corrective action requests by verification team	Ref. to checklist question in table 1	Summary of project owner response	Verification team conclusion
<b>CAR 1 :</b> During maintenance of monitoring system (06/07/2013), 1 hour (10:00 AM) methane concentration in the worksheet is not consistent with the log data documented manually. - Worksheet: 54.5% - Log data: 54.4%	4.4.2	The PP mistakenly applied 54.5% in the worksheet and corrected to 54.4% for 10:00 AM 06/07/2013 methane concentration data.	The verification team confirmed that the methane concentration of 54.4% is correctly applied for 10:00 AM 06/07/2013 in the worksheet as well as emission reduction calculations.  <b>CAR 1 is closed.</b>
<b>CAR 2:</b>  The imported electricity data during 19/07/2013~18/08/2013 is not provided. Please provide the data with relevant evidence and reflect in the excel spreadsheet as well the MR.	4.4.1 6.2	Receipts of imported electricity are issued on the 2 <sup>nd</sup> day each month and the receipt for 19/07/2013~18/08/2013 was not issued during the site visit. The PP provided the receipt and reflect the data in the excel spreadsheet.	The verification team checked the receipt for the imported electricity and confirms that the imported electricity data are correctly applied in the worksheet as well as emission reduction calculations.  <b>CAR 2 is closed.</b>
<b>CAR 3:</b>  GWP <sub>CH4</sub> applied for 2013 ex-ante parameter is not in line with EB decision.	1.5 (d)	The PP applied GWP <sub>CH4</sub> of 21 for 2013 and revised to 25.	The verification team confirmed that GWP <sub>CH4</sub> for 2nd commitment period of Kyoto Protocol is in line with decision 4/CMP 7 . GWP <sub>CH4</sub> of 25 is correctly applied for 2013 worksheet as well as emission reduction calculations.  <b>CAR 3 is closed.</b>
<b>CAR 4:</b>	1.3.2.3 1.4.3	During the 4 <sup>th</sup> monitoring period, a watt-meter for 2nd generator was	The existing meter (Wa) was measuring exported

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<p>New Watt-hour meter was installed during 4<sup>th</sup> monitoring period. Please explain how exported electricity is measured by KPX.</p>	<p>2.7 4.1 4.2 4.3</p>	<p>installed on 27 January 2013 and has been used since 30 January 2013.</p> <p>The watt-meter for 2nd generator was added under the “Act on the promotion of the development, use and diffusion of new and renewable energy”. Before installation, total amount of exported electricity out of project had been monitored by main watt-hour meter (Wa) as shown in figure below.</p> <p>In this exported electricity measuring system, the relation between exported electricity is <math>W_a</math> (the total amount of exported electricity) = <math>W_c</math> (amount of electricity for the 2nd generator) + Amount of electricity for the 1st generator.</p> <p>Accordingly, from 30 January 2013, the monitoring of <math>EL_{EXP,y}</math> has been changed.</p> <p>When 1<sup>st</sup> generator operates or 1<sup>st</sup> generator and 2<sup>nd</sup> generator operate, <math>W_a</math> is used to measure the amount of exported electricity. When 2<sup>nd</sup> generator operates, <math>W_c</math> is used to measure the exported electricity. The MR and the PDD were revised accordingly.</p>  <p>Measurement G = CH<sub>4</sub> analyzer F = Flow meter W = Watt-hour meter</p>	<p>electricity from both 1st generator and 2nd generator. As per national regulation “Act on the promotion of the development, use and diffusion of new and renewable energy”, the electricity generation from 1<sup>st</sup> generator and 2<sup>nd</sup> generator should be measured separately because the commercial operation starting date is different<sup>*</sup>. Accordingly, the PP is requested to measure the electricity generation separately and the PP installed new meter (<math>W_c</math>) on 27 January 2013 to measure electricity from 2<sup>nd</sup> generator in attendance with KPX, the grid company; the new meter has been used since 30 January 2013. The validation team reviewed the national regulation and the official document and confirms that the installation of <math>W_c</math> is not within the control of PP.</p> <p>Thus, it is confirmed that the change does not require prior approval by the Board in accordance with appendix 1 of Project standard and requested post-registration change.</p> <p>As described in the revised monitoring diagram, from 30 January 2013, <math>W_a</math> measures electricity from 1st and 2nd generators; <math>W_c</math> measures electricity from 2nd generator. When only 1st generator operates or 1<sup>st</sup> generator and 2<sup>nd</sup> generator operate together<sup>†</sup>, the exported electricity is measured by <math>W_a</math>; when only 2nd generator operates, the exported electricity is measured by <math>W_c</math>. The verification team confirmed through interviewing the PP and relevant personnel in KPX</p>
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<sup>\*</sup> 1<sup>st</sup> generator started commercial operation in September 2008 and 2<sup>nd</sup> generator started commercial operation in June 2009.

<sup>†</sup> As for Mokpo LFG power plant, 2<sup>nd</sup> generator is used as auxiliary generator and does not normally operate in parallel with 2<sup>nd</sup> generator.

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			<p>Thus, permanent change from the registered monitoring plan is requested as post registration change during this 4<sup>th</sup> verification.</p> <p>The verification team checked that the monitoring plan is in accordance with the applied methodology (AMS I. D version 13)* and the monitoring has been implemented as per the monitoring plan in the revised PDD<sup>†</sup>.</p> <p>Thus, the verification team confirms that the monitoring is in accordance with the monitoring plan in the revised PDD (version 05, dated 29 November 2013).</p> <p><b>CAR 4 is closed.</b></p>
<p><b>CAR 5</b></p> <p>The monitoring period of the MR published in the UNFCCC website is 19/08/2012~18/05/2013. And the monitoring period of the revised MR (version 2, dated on 20/08/2013) is 19/08/2012~18/08/2013. Please explain why the monitoring period has been changed.</p>	1.2.1	<p>The PP had prepared the MR for 19/08/2012~18/05/2013, which was published in the UNFCCC website on 06/08/2013. The PP prepared the MR (version 2, dated on 20/08/2013) on site covering data 19/08/2012~18/08/2013 and requested for verification.</p>	<p>The monitoring period of the MR published in the UNFCCC website (on 06/08/2013) is 19/08/2012~18/05/2013.</p> <p>And the PP requested for change in the monitoring period to 19/08/2012~18/08/2013 as they prepared for 3 more month emission reduction data.</p> <p>The verification team thoroughly examined the data and events for the extended period (including imported electricity for 19/07/2013~18/08/2013 (CAR 3)) and confirms that there is no concern.</p> <p>Thus, as per EB 41 meeting report para. 78, the verification team confirmed this monitoring period change is valid.</p> <p><b>CAR 5 is closed.</b></p>

\* The other applied methodology, AMS III. G (version 06), is not relevant to this post registration change.

† Detailed assessment is described in the validation opinion for the post registration change.

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<p><b>CL 1:</b></p> <p>Operation event in B.1 of the MR</p> <p>1. Some operation events are not consistent with operation log. (e.g. 19/04/2013~25/04/2013)</p> <p>2. Some maintenance of power plants events is not specified. (e.g. 05/10/2012)</p> <p>3. The data on 08/07/2013 is normal but it is recorded as operation event.</p>	<p>1.3.1</p>	<p>1. The PP mistakenly described some operation events and revised the MR.</p> <p>2. The PP specified power plants for those events.</p> <p>3. The PP revised the MR and deleted the event.</p>	<p>1. The verification team confirms that the MR is correctly revised.</p> <p>- 06/10/2012: 4 hours → 3 hours</p> <p>- 19/04/2013~25/04/2013:153 hours → 143 hours</p> <p>2. The verification team confirms that the specified power plants in the revised the MR are consistent with the log and data. .</p> <p>- eg. 05/10/2012 : 1<sup>st</sup> generator</p> <p>3. The verification team confirms that the MR is correctly revised.</p> <p><b>CL 1 is closed.</b></p>
<p><b>CL 2:</b></p> <p>Please demonstrate the accuracy of emission reduction calculations for 2012 and 2013</p>	<p>4.5</p>	<p>The imported electricity for 19/12/2012 ~ 18/01/2013 is 0.336 MWh and the imported electricity can not be allocated daily basis because there is no daily imported electricity record. Thus, 0.336 MWh is applied for 19/12/2012 ~ 31/12/2012 and 01/01/2013 ~ 18/01/2013 respectively to conservatively calculate emission reductions achieved up to 31/12/2012 and from 01/01/2013</p> <p>Also, the PP revised the MR as well as the excel spreadsheet to show the emission reductions for each year.</p>	<p>The verification team checked the monthly bills from KEPCO.</p> <p>The verification team checked the MR and the excel spreadsheet and confirms that the emission reduction for each year is correctly calculated in the excel spreadsheet and correctly described in the MR.</p> <p><b>CL 2 is closed.</b></p>
<p><b>CL 3:</b></p> <p>GPS coordinates in the PDD and MR are not consistent with the physical location of the project.</p>	<p>1.2.2 1.3.2.2 2.8</p>	<p>The GPS coordinates in the registered PDD and the MR is mistakenly applied and the GPS is corrected to latitude of 34.8328 and longitude of 126.4096 based on the power plant.</p>	<p>The verification team checked the geographic coordinate in the PDD and the MR using google earth and the area is shown as agricultural area. The verification team searched the geographic coordinates with the site address in google earth and confirms that latitude of 34.8328 and longitude of 126.4096 based on the power plant are correct.</p> <p>Due to this inconsistency, correction is requested. In this case it is related to the location and thus, applied to 'Appendix 1. Changes that do not require prior approval by the board' of Annex 2, EB 70.</p>



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			<p>The verification team confirms that the corrected GPS information is consistent with the revised PDD and the correction complies with the requirement of the CDM Project Standard (version 2.1).</p> <p><b>CL 3 is closed.</b></p>
<p><b>CL 4:</b></p> <p>Revised monitoring plan for EL<sub>EXP,PJT,y</sub> was not reflected in the monitoring manual.</p>	<p>2.1 of Table 2</p>	<p>The monitoring manual was not updated and the PP revised the monitoring manual (version 14.0, dated 01/10/2013) reflecting new watt-hour meter (Wc).</p>	<p>The verification team reviewed the revised monitoring manual and confirms that the monitoring plan reflects the actual monitoring and complies with the revised PDD.</p> <p><b>CL 4 is closed.</b></p>

Appendix B  
Qualification of Verification Team



## CERTIFICATE OF COMPETENCE

**Name:** Eun Jung KIM

**Qualification:**

	Validation	Verification
-Lead auditor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

1.2 Energy generation from renewable energy sources

13.1 Waste handling and disposal

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 30 June 2013.

Sustainability Management Institute  
Sang Yeon PARK

A handwritten signature in black ink, appearing to be 'S. Y. Park', written over a horizontal line.



## CERTIFICATE OF COMPETENCE

**Name:** Jin Seok CHO

**Qualification:**

	Validation	Verification
-Lead auditor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

**Technical Area (TA)**

1.2 Energy generation from renewable energy sources

He is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 30 March 2013.

Sustainability Management Institute  
Sang Yeon PARK

A handwritten signature in black ink, appearing to be 'S. Y. Park', written over a horizontal line.

Appendix C  
Qualification of Technical Reviewer



## CERTIFICATE OF COMPETENCE

**Name:** Sung Han YOON

**Qualification:**

	Validation	Verification
-Lead auditor	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
-Auditor	<input type="checkbox"/>	<input type="checkbox"/>
-Technical Expert	<input type="checkbox"/>	<input type="checkbox"/>
-Local Expert	<input type="checkbox"/>	<input type="checkbox"/>

**Scopes of Expertise:**

**Technical Area (TA)**

- 1.1 Thermal energy generation from fossil fuels and biomass including thermal electricity from solar
- 1.2 Energy generation from renewable energy sources
- 11.2 GHG capture and destruction.
- 13.1 Waste handling and disposal

He is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 6 January 2012.

Sustainability Management Institute  
Nam Hoon KIM

A handwritten signature in black ink, appearing to read 'Nam Hoon KIM'.