



VERIFICATION AND CERTIFICATION REPORT

MOKPO LANDFILL GAS RECOVERY PROJECT FOR ELECTRICITY GENERATION

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Summary: Korean Foundation for Quality (KFQ) has performed the third periodic verification of the CDM project "Mokpo Landfill Gas Recovery Project for Electricity Generation", UNFCCC Registration Ref. No. 2834 for the period 18 July 2011~ 18 August 2012. 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 11 September 2012, 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"> the project has been implemented and operated in accordance with the description given in the registered PDD (version 04, dated 27/11/2009, registration date 18/02/2010) the monitoring plan complies with the applied methodology (<i>AMS-I.D Version 13, AMS-III.G Version 6</i>) the monitoring has been carried out as per the revised monitoring plan approved on 19 January 2011 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. 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 40,670 t CO ₂ e of emission reductions during the monitoring period 18 July 2011~ 18 August 2012 which is within the fixed crediting period from 18-02-2010 to 17-02-2020.			

Work carried out by : Sang Yeon PARK (Audit team leader, GHG auditor)  Mi Jung LEE (Auditor team member, GHG auditor) Kyoung Ae PARK (Auditor team member, Observer)	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 ₂	Carbon dioxide
CO ₂ 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 18/07/2011 ~ 18/08/2012.

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 registered PDD “*Mokpo Landfill Gas Project for Electricity Generation*” version 4, 27 November 2009, 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 03.0 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 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-

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site assessment to ensure the conformity of the actual project activity and its operation with the registered 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 CH₄ (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 reductions in the registered PDD are 25,795 tons CO₂e 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.

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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 34:48 N and latitude of 126:22 E)
Date of registration	18/02/2010
Crediting period	18/02/2010 ~ 17/02/2020
Monitoring period of this verification	18/07/2011 ~ 18/08/2012

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, 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.

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

The verification team consisted as follows:

Sang Yeon PARK (Audit team leader, GHG auditor)

Mi Jung LEE (Auditor team member, GHG auditor)

Kyoung Ae PARK (Auditor team member, Observer)

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

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

2.1 Review of Documentation

The monitoring report version 01 (23/08/2012) 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 24 August 2012.

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 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

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On 11 September 2012, 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

Interviewed organisation	Interview topics
Hanwha Corporation - Kun Hong LEE - Hey-young Yang Econetwork Co., Ltd (Consulting company) - Hyeon Gu HA - Eu Ddeum PARK	- 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

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 is 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.

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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.

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:

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3.1 FARs from previous verification

FAR was not issued from previous verification.

3.2 Project Implementation against the registered PDD

KFQ has performed an on-site assessment to verify the real implementation of the Project as per registered PDD 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 website¹.

All facilities and equipment for this project activity are in place as described in the registered PDD except LFG collecting system (the number of vertical well, well head, and trap).

There has been no change of LFG collecting system since 2nd monitoring period (18 August 2010 ~ 17 July 2011) and the difference of LFG collecting system consisting of well, well trap etc. between described in PDD and current status was identified in 1st and 2nd monitoring period respectively and confirmed at the verification for each monitoring period.

The number of vertical wells in PDD is indicated as 121 but actual total number of installed wells is 156. Each wellhead has been connected to the 12 vertical wells and 13 wellheads² were trapped in February 2011..

Installation Date	Well No.	Well head No.	Vertical well	J-Trap	Remark
	121	11	11	117	PDD
Apr. 2009	132	11	12	117	

¹ <http://cdm.unfccc.int/Projects/DB/emc1249265030.9/view>

² Existing wellhead were relocated and new wellhead was trapped to activate methane gas capture.

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Feb. 2011	156	13	12	125	Current status
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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

This LFG collecting system change will contribute recovery efficiency improvement but at the time of validation, the ER was calculated under assumption that 100% of generating LFG estimated by the methodological tool is recovered. Thus, verification team concluded that it does not have an influence on estimated ER and this change also does not effect to the additionality of this project activity.

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. While checking the records and data, verification team confirms that PP correctly recorded all operational events in daily operation record and the main operational events has been also summarized in the MR (ver.05).

Emission reductions during this monitoring period are 40,670 t CO₂e for 398 days and emission reductions as projected in the PDD are 27,405 t CO₂e for 398 days (annual allocation of ER converted into monitoring days: 24,831 t CO₂e × 167d/365d + 25,350 t CO₂e × 231d/365d). Actual emission reductions of this project for monitoring are increased by 48% 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 6.05 m³/min of LFG flow, 50 % CH₄ concentration (average of annual estimated LFG flow in the PDD: 5.97 m³/min × 167d/398d + 6.1 m³/min × 231d/398d = 6.05 m³/min). But the actual average LFG flow (8.24 m³/min) and actual CH₄ concentration (52.13 %) exceeds the estimated values applied to the ER calculation in PDD.

Furthermore, the verification team reviewed annual amount of waste quantity since 2007 and found that the amount of waste quantity during 2007 ~ 2011 was increased by 9.84 % than the estimated quantity in registered PDD. As the amount of waste is increased, LFG generation 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

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uncertainty between model and real LFG generation can be seen in the other paper¹).

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 (6,759.616 MWh) was not over than the value in the PDD (yearly allocation of estimated power generation in the PDD converted into monitoring days: $6,259 \text{ MWh} \times 167\text{d}/365\text{d} + 6,390 \text{ MWh} \times 231\text{d}/365\text{d} = 6,907.79 \text{ MWh}$). Considering power generator's efficiency is various based on content of CH₄ 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.

Nevertheless CAR 1, CAR 2 and CL 1 were raised in the course of the verification and were successfully closed (Ref. Annex: Verification Protocol – Table 3).

3.3 Compliance of the Monitoring Plan with the Monitoring Methodology

For the monitoring period, the project activity applied the revised monitoring plan which was approved on 19 January 2011 during initial and first verification. The revised monitoring plan 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.

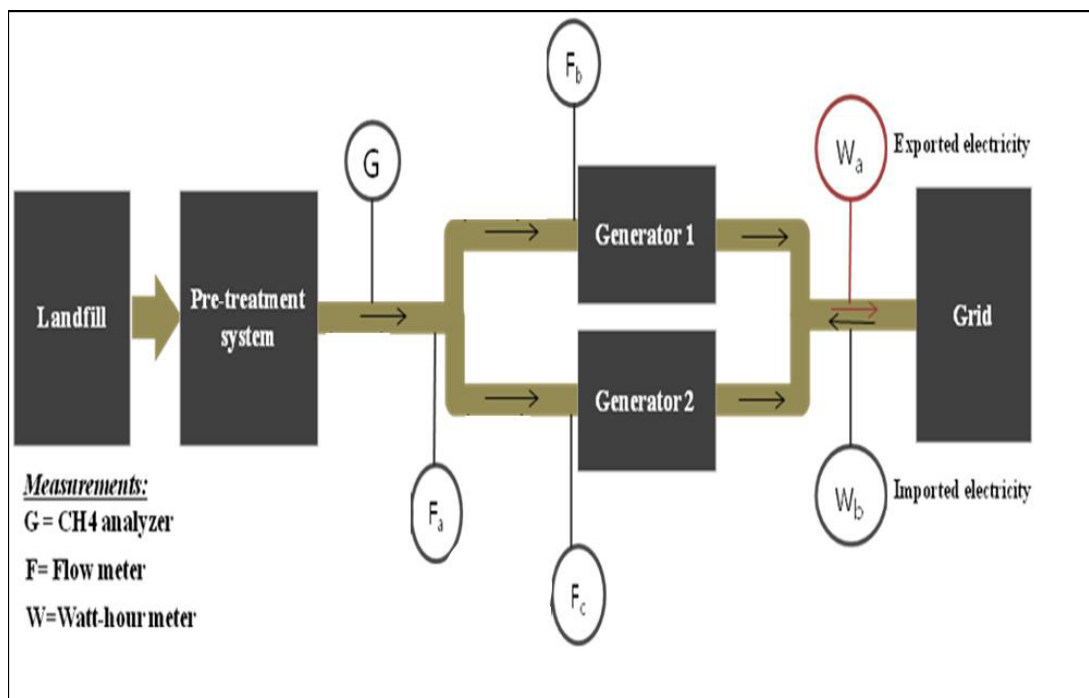
3.4 Compliance of the Monitoring with Monitoring Plan

The monitoring has been carried out in accordance with the revised monitoring plan approved on 19 January 2011. All parameters were monitored and determined as per the revised Monitoring Plan.

In this project, 3 flow meters, 1 gas analyzer and 2 watt-hour meters were installed for the monitoring.

The layout of monitoring equipment is shown in figure 1.

¹ 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)



[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. 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	F
Data Unit	-
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.

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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 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	GWP_{CH4}
Data Unit	tCO ₂ e / t CH ₄
Description	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used	Decisions under UNFCCC and the Kyoto Protocol
Value(s)	21
Means of verification/comments	There was no change and the value of 21 was used for the project correctly.

Data/Parameter	LFG_{electricity, y}
Data Unit	Nm ³ /y
Description	Amount of landfill gas combusted in power plant
Source of data used	Amount of landfill gas combusted in power plant is measured by gas flow meters and the data is taken from centralized monitoring system data server.

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Value(s)				

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	<p>the on-site visit.</p> <p>By the way, flow meter (SN:812003) installed at 1st generator (F_b) was replaced with meter of SN:906044A at 2nd generator during 13 February ~ 18 March 2012. The validation team found two generators are not operated at the same time at site inspection and confirmed it through measured $LFG_{\text{electricity},y} (Nm^3)$ in raw data sheet of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date'. So, meter of SN:906044A was used for F_b to measure flow data of LFG combusted in 1st generator during this period. The measuring value during this period is indicated in column of F_c in the spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction' ver. 03.0. The verification team also confirmed replacement of flow meter installed at F_b through daily work log.</p> <p>Furthermore, the verification team made sure F_b can be replaced with F_c to measure amount of landfill gas combusted in power plant through official documents regarding to compatibility of meter spec and monitoring system issued by manufacturer (Flow Technology Co., Ltd.) and data server maintenance company (BB system) respectively.</p> <p>Other flow meter (Tag: F_a total flow meter) was located in front of the branch of pipeline to each power generator and was used for cross checking with sum of F_b and F_c. The material balance was checked with daily data. Considering of each meters' uncertainty, the gap of material balance within unique meter's error range is acceptable. As a result of cross check through raw data sheet of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date', verification team identified that there was no gap exceeded unique meter's error between F_a, and sum of F_b and F_c during this monitoring period.</p> <p>Each flow meter sends signals continuously to the data server and the accumulated data registered by electronic file continuously. The type of flow meter is thermal mass flow meter and the measured value was recorded as normalized cubic meters by automatically according to measured temperature and pressure.</p> <p>While the flow data was transferred to the server, occasionally delayed data server processing occurred and during this time, there is no data transmission from flow meter to data server temporarily. (hereafter this phenomenon is called as data lag). In this case, there is no spot flow data</p>
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		<p>but it is possible to measure total flow while data lag occurred because the type of measuring equipment is an integrating meter.</p> <p>On the other hand, a part from data lag, during this monitoring period the data from flow meter was not transferred to data server because data server’s malfunction or maintenance of monitoring system occurred on 7 September 2011 and 21 October 2011. Thus, PP recorded the flow rate data manually hourly according to the emergency procedure in operating manual and applied this data in BE calculation.</p> <p>Also, the generator for the project was not operated during black out of the project site and maintenance of equipment including the replacement of flow meter. During these events, PP considered measured flow data as ‘0’ and applied the value in BE calculation. 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, spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ and raw data sheet of ‘LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date’ and confirmed that all data applied to BE calculation are consistent and correct.</p>		
Verified Meter’s Information				
Description		Main flow	1 st Generator (Flow 1)	2 nd Generator (Flow 2)
Tag		F _a	F _b	F _c
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		18-07-2011 ~ 18-08-2012	18-07-2011 ~ 12-02-2012 04-04-2012 ~ 18-08-2012 (Detached period for calibration: 13-02-2012 ~ 03-04-2012) (Period which 906044A was	18-07-2011 ~ 18-08-2012

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		installed at 1 st generator (F _b): 13-02-2012 ~ 18-03-2012)	
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>For calibration of flow meter (SN:812003) installed at 1st generator (F_b), it was detached from 1st generator during 13 February 2012 ~ 3 April 2012. Meter of SN:906044A replaced the flow meter (SN:812003) and was used for F_b to measure flow data of LFG combusted in 1st generator during 13 February ~ 18 March 2012. Meter of SN:906044A was attached to 2nd generator (F_c) again to measure flow data of LFG combusted in 2nd generator on 18 March 2012. After calibration, the meter of SN:812003 was reattached on 1st generator (F_b) on 3 April 2012. Thus, the verification team confirmed flow data was not measured by the meter installed at F_b during 18 March 2012 ~ 1 April 2012.</p> <p>Therefore 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 _{CH₄,y}	
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 ₄ concentration (%)
	18/07/2011 ~ 18/08/2012	52.13
	Please refer to the spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction' ver. 03.0.	
Means of verification/comments	The gas analyzer is located in front of total flow meter (F _a). Gas analyzer sends signals continuously to the data server (centralized monitoring system). W _{CH₄,y} in spread sheet of 'Mokpo_3rd	

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	<p>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 with the same frequency as the flow in the data server.</p> <p>As mentioned in flow data of LFG, data lag occasionally occurred, while the concentration of CH₄ was transferred to the server. Thus, the determination of CH₄ concentration among measured data during the data lag would be required for BE calculation. As a conservative manner, PP applied the logic that CH₄ value was determined as the lower value between current measuring data and previous measuring data in every recording time.</p> <p>This correction logic was applied in the raw data sheet of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date' and BE was calculated with this corrected data. The verification team confirmed this approach is conservative and correctly applied.</p> <p>During this monitoring period, CH₄ concentration was not transferred to data server on 7 September 2011 (1 hour) and 21 October 2011 (2 hours) with problem of monitoring system as mentioned above (flow data of LFG). At that time, PP recorded the CH₄ concentration manually in every hour according to the emergency procedure in operating manual and applied this data in BE calculation. The validation team reviewed hourly CH₄ concentration recorded by PO at the time of problem of monitoring system and confirmed methane analyzer functioned properly at that time through daily work log.</p> <p>CH₄ concentration was not measured during two hours as pipeline connected to gas analyzer was frozen on 24 January 2012. PP applied CH₄ concentration of '0%' to BE calculation in a conservative manner as they don't know CH₄ concentration at the time. These events can be identified in the event history in section B.1 (Table B-1) of MR.</p> <p>Meanwhile, according to the manufacture's opinion for the normal operation condition of gas turbine generator used LFG, the 40% of CH₄ concentration is required for normal operation. (It is identified with the official document provided by the gas turbine engine generator supply company, RNP Enterprise Ltd.). Thus, if CH₄ concentration was measured under 40%, it can be thought to be the gas turbine generator is on abnormal operation. Therefore, PP also regarded measured CH₄</p>
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		concentration under 40% as ‘0%’ for BE calculation in a conservative manner. Verification team checked the daily work log, the operating manual, spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ and raw data sheet of ‘LFG flow rates & CH ₄ fraction (Mokpo LFG plant)_date’ and confirms that all data applied to BE calculation are consistent and reliabel.		
Verified Meter’s Information				
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) 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		18-07-2011 ~ 18-08-2012		
The applied period of max. permissible error when applicable		-		
Means of verification/comments		According to the approved revised monitoring plan, PP decided to adopt three (3) years of calibration frequency and accuracy level of this meters are 1% (as a linearity). 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 National Metrology Institute and confirmed gas analyzer is valid to measure methane concentration and no delayed calibration during this monitoring period. 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 ₂ gas. Span calibration is for span point adjustment. For span calibration, certified standard gases (CH ₄ , CO ₂ and O ₂) were used.		

VERIFICATION AND CERTIFICATION REPORT

	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	The amount of exported electricity are measured automatically by certified watt-hour meter and got from KPX website (E-power market).																																	
Value(s)	<table><tr><th>Date</th><th>Measured EL_{EXP} (MWh)</th></tr><tr><td>18/07/2011</td><td>18.355</td></tr><tr><td>19/07/2011 ~ 18/08/2011</td><td>516.455</td></tr><tr><td>19/08/2011 ~ 18/09/2011</td><td>539.142</td></tr><tr><td>19/09/2011 ~ 18/10/2011</td><td>546.713</td></tr><tr><td>19/10/2011 ~ 18/11/2011</td><td>547.385</td></tr><tr><td>19/11/2011 ~ 18/12/2011</td><td>536.788</td></tr><tr><td>19/12/2011 ~ 18/01/2012</td><td>535.639</td></tr><tr><td>19/01/2012 ~ 18/02/2012</td><td>523.916</td></tr><tr><td>19/02/2012 ~ 18/03/2012</td><td>489.525</td></tr><tr><td>19/03/2012 ~ 18/04/2012</td><td>500.182</td></tr><tr><td>19/04/2012 ~ 18/05/2012</td><td>491.151</td></tr><tr><td>19/05/2012 ~ 18/06/2012</td><td>505.683</td></tr><tr><td>19/06/2012 ~ 18/07/2012</td><td>491.310</td></tr><tr><td>19/07/2012 ~ 18/08/2012</td><td>517.374</td></tr><tr><td>2011-07-18 ~ 18/08/2012</td><td>6,759.616</td></tr></table>		Date	Measured EL _{EXP} (MWh)	18/07/2011	18.355	19/07/2011 ~ 18/08/2011	516.455	19/08/2011 ~ 18/09/2011	539.142	19/09/2011 ~ 18/10/2011	546.713	19/10/2011 ~ 18/11/2011	547.385	19/11/2011 ~ 18/12/2011	536.788	19/12/2011 ~ 18/01/2012	535.639	19/01/2012 ~ 18/02/2012	523.916	19/02/2012 ~ 18/03/2012	489.525	19/03/2012 ~ 18/04/2012	500.182	19/04/2012 ~ 18/05/2012	491.151	19/05/2012 ~ 18/06/2012	505.683	19/06/2012 ~ 18/07/2012	491.310	19/07/2012 ~ 18/08/2012	517.374	2011-07-18 ~ 18/08/2012	6,759.616
Date	Measured EL _{EXP} (MWh)																																	
18/07/2011	18.355																																	
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19/07/2012 ~ 18/08/2012	517.374																																	
2011-07-18 ~ 18/08/2012	6,759.616																																	
Means of verification/comments	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 _{EXP,PJT,y} in the spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ have been verified against the data from E-power Market of KPX during the site visit.																																	

VERIFICATION AND CERTIFICATION REPORT

		Verification team checked that total amount of electricity exported to grid during this monitoring period is 6,759.616 MWh and concluded that this value is correct.		
Verified Meter’s Information				
Tag		W _a		
I.D/ Serial No.		95246742		
Type		Watt-hour meter	Accuracy level	0.5S
Calibration Entity		Meter and Petrochemical testing and research Institute (initial test) Korea Testing Certification (latest calibration)	Calibration frequency	Two years
Previous calibration (Initial test)	Test date	28-08-2008		
	validity	27-08-2010		
Latest calibration	Test date	25-08-2010		
	validity	24-08-2012		
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 this meters are 0.5s. The verification team reviewed initial test report (28 August 2008) issued by Meter and Petrochemical testing and research Institute and second test report (25 August 2010) issued by Korea Testing Certification and confirmed watt-hour meter for exported electricity is valid to measure electricity exported to the grid for this monitoring period.		

Data/Parameter	EL _{IMP,PJT,y}
Data Unit	MWh
Description	Amount of imported electricity meter
Source of data used	The amount of imported electricity are measured automatically by certified watt-hour meter and got from the bill issued by KEPCO.

VERIFICATION AND CERTIFICATION REPORT

Value(s)	Date		Measured EL _{IMP} (MWh)	Corrected EL _{IMP} * (MWh)
	18/07/2011		0.312	0.317
	19/07/2011 ~ 18/08/2011		0.648	0.658
	19/08/2011 ~ 18/09/2011		0.096	0.097
	19/09/2011 ~ 18/10/2011		0.022	0.022
	19/10/2011 ~ 18/11/2011		0.096	0.096
	19/11/2011 ~ 18/12/2011		0.048	0.048
	19/12/2011 ~ 18/01/2012		0.048	0.048
	19/01/2012 ~ 18/02/2012		0.096	0.096
	19/02/2012 ~ 18/03/2012		0.096	0.096
	19/03/2011 ~ 18/04/2012		0.864	0.864
	19/04/2012 ~ 18/05/2012		0.024	0.024
	19/05/2012 ~ 18/06/2012		0.072	0.072
	19/06/2012 ~ 18/07/2012		0.024	0.024
	19/07/2012 ~ 18/08/2012		0.120	0.120
	18/07/2011 ~ 18/08/2012		2.566	2.582
	* Maximum permissible error is applied to correct data during 18 July 2011 ~ 26 September 2011 as delayed calibration of meter.			
Means of verification/comments		The amount of imported electricity is measured automatically by certified watt-hour meter. Mokpo LFG power operating team can check at the website of KEPCO and the monthly bills for imported electricity issued by KEPCO. Verification team checked that total amount of electricity imported from grid during this monitoring period is 2.582 MWh through monthly bill for imported electricity from KEPCO.		
Verified Meter's Information				
Tag		W _b		
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)	Test date	22-08-2008		
	validity	21-08-2010		

VERIFICATION AND CERTIFICATION REPORT

Latest calibration	Test date	27-09-2011
	validity	26-09-2013
The applied period of max. permissible error when applicable		18-07- 2011 ~ 26-09-2011
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 meters are 1s.</p> <p>The verification team reviewed initial test report (22 August 2008) issued by LS industrial Co., Ltd. and second test report (27 September 2011) issued by KTC and found delayed calibration (18 July 2011 ~ 26 September 2011) during this monitoring. The result of second test implemented on 27 September 2011 was smaller than the maximum permissible error.</p> <p>Because the second calibration was delayed, the data of imported electricity was corrected applying the maximum permissible error of watt-hour meter according to “CDM VVS (version 03.0)” during 18 July 2011 ~ 18 October 2011 as a conservative manner. Actually the validity of latest calibration is from 27 September 2011 but the correction period (27 September 2011 ~ 18 October 2011) is decided considering electricity use period in the bill (19 previous month ~ 18 current month). PP applied 1.5% for correction of the data as a conservative manner even though 1 % (the maximum permissible error of the used watt hour meter during this monitoring period) was required.</p>

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

Nevertheless, CAR 3, CAR 4 and CL 2 were raised in the course of the verification and were successfully closed (Ref. Annex: Verification Protocol –Table 3).

3.5 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.

VERIFICATION AND CERTIFICATION REPORT

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 3rd Monitoring Report” is correct.

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

The calculation of emission reduction is as follows:

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

Parameter	Unit	Description
MD _y	tCO _{2e}	CO ₂ equivalent of the methane captured and destroyed/ gainfully used by the project activity in year y;
MD _{reg,y}	tCO _{2e}	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 _{2e} /MWh	Combined emission factor in electricity generation by grid-connected system; weighted average of EFOM and EFBM.

Furthermore, verification team confirms that the emission factor (ex-ante values from PDD, 0.5375 tCO_{2e}/MWh) is already justified and applied correctly for emission reduction calculation. No assumptions and default values are applied for the calculation.

$$MD_y = LFG_{electricity,y} * w_{CH4,y} * D_{CH4,y} * GWP_{CH4}$$

Parameter	Unit	Description
LFG _{electricity,y}	Nm ³	Landfill gas flared or used as fuel in the year ‘y’
w _{CH4,y}	%	Methane content in landfill gas in the year ‘y’(mass fraction)
D _{CH4,y}	ton/ Nm ³	Density of methane at the temperature and pressure of the landfill gas in the year ‘y’ (0.0007168 ton/Nm ³ -CH ₄) In this project activity, LFG _{electricity,y} was monitored as Nm ³ with thermal mass flow meter. Thus, the density of methane under STP (Standard

VERIFICATION AND CERTIFICATION REPORT

		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 _{CH4}	tCO ₂ /tCH ₄	Global warming potential of methane (21 CO _{2e} /CH ₄)

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

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_3rd MR_R2834_Emission Reduction' and raw data sheet of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date' and the calculation result is appropriate.

Baseline emission

Period	LFG _{electricity,y} (Nm ³)	W _{CH4,y} (%)	EL _{EXP, PJT, y} (MWh)	Applied Value for BE (t CO _{2e})
18/07/2011	12,420.300	54.35	18.355	111.473
19/07/2011 ~ 18/08/2011	350,519.300	53.79	516.455	3,115.611
19/08/2011 ~ 18/09/2011	351,237.300	56.91	539.142	3,298.579
19/09/2011 ~ 18/10/2011	346,735.600	54.34	546.713	3,129.790
19/10/2011 ~ 18/11/2011	353,222.400	53.48	547.385	3,137.930
19/11/2011 ~ 18/12/2011	374,906.900	54.35	536.788	3,355.973
19/12/2011 ~ 18/01/2012	380,767.700	51.55	535.639	3,242.809
19/01/2012 ~ 18/02/2012	372,470.500	49.89	523.916	3,078.790
19/02/2012 ~ 18/03/2012	346,027.300	49.48	489.525	2,840.140
19/03/2011 ~ 18/04/2012	329,727.200	49.48	500.182	2,724.602
19/04/2012 ~ 18/05/2012	357,855.500	49.50	491.151	2,930.284
19/05/2012 ~ 18/06/2012	376,931.700	49.47	505.683	3,078.591
19/06/2012 ~ 18/07/2012	368,382.300	50.88	491.310	3,085.500

VERIFICATION AND CERTIFICATION REPORT

19/07/2012 ~ 18/08/2012	398,421.000	54.42	517.374	3,541.679
Total	4,719,625.000	52.13	6,759.616	40,671.729

The amount of LFG consumption in power generation ($LFG_{\text{electricity},y}$) during this monitoring period from 18 July 2011 to 18 August 2012 is 4,719,625.000 Nm³ and weighted average methane concentration of LFG is 52.14 %. There is no other LFG treatment activity by regulation in the site. It was already justified that $MD_{\text{reg},y}$ 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 ($EL_{\text{EXP}, \text{PJT}, y}$) is 6,759.616 MWh during this monitoring period.

Thus, BE_y is calculated as bellows;

$$BE_y = \{(4,719,625.000 \text{ Nm}^3 \times 52.1348 \% (\text{CH}_4/\text{LFG}) \times 0.0007168 \text{ ton ton/Nm}^3\text{-CH}_4 \times 21) - 0\} + 6,759.616 \text{ MWh} \times 0.5375 \text{ tCO}_2\text{e/MWh} = 40,671.729 \text{ tCO}_2\text{e/MWh}$$

Project emission

Period	$EL_{\text{IMP}, \text{PJT}, y}$ (MWh)	Applied Value for PE (t CO₂e)
19/06/2011 ~ 18/07/2011	0.317	0.170
19/07/2011 ~ 8/08/2011	0.658	0.354
19/08/2011 ~ 8/09/2011	0.097	0.052
19/09/2011 ~ 8/10/2011	0.022	0.012
19/10/2011 ~ 8/11/2011	0.096	0.052
19/11/2011 ~ 18/12/2011	0.048	0.026
19/12/2011 ~ 18/01/2012	0.048	0.026
19/01/2012 ~ 18/02/2012	0.096	0.052
19/02/2012 ~ 18/03/2012	0.096	0.052
19/03/2011 ~ 18/04/2012	0.864	0.464
19/04/2012 ~ 18/05/2012	0.024	0.013
19/05/2012 ~ 18/06/2012	0.072	0.039
19/06/2012 ~ 18/07/2012	0.024	0.013
19/07/2012 ~ 18/08/2012	0.120	0.065
Total	2.582	1.388

The electricity imported electricity to the grid ($EL_{\text{IMP}, \text{PJT}, y}$) is 2.582 MWh during this monitoring period.

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$$PE_y = 2.582 \text{ MWh} \times 0.5375 \text{ tCO}_2\text{e/MWh} = 1.388 \text{ tCO}_2\text{e}$$

Leakage

Emissions due to leakage are zero according to the registered PDD

Emission reductions

$$\begin{aligned} ER_y &= BE_y - PE_y - LE_y \\ &= 40,671.729 \text{ tCO}_2\text{e/MWh} - 1.388 \text{ tCO}_2\text{e} - 0 \\ &\doteq 40,670 \text{ tCO}_2\text{e/MWh} \end{aligned}$$

ERs in MR (version 01) opened to the public on 25 August 2012 are 40,672 tCO₂e, whereas ERs in revised MR (version 05) is 40,670 tCO₂e. The difference of the value between opened MR (version 01) and revised MR (version 05) mainly results from change of LFG_{electricity,y} and W_{CH4,y}.

Period	Value in MR_open (t CO ₂ e)	Verified Value in MR_final (t CO ₂ e)
19/06/2011 ~ 18/07/2011	111.305	111.303
19/07/2011 ~ 18/08/2011	3,115.713	3,115.257
19/08/2011 ~ 18/09/2011	3,298.528	3,298.527
19/09/2011 ~ 18/10/2011	3,129.778	3,129.778
19/10/2011 ~ 18/11/2011	3,137.897	3,137.879
19/11/2011 ~ 18/12/2011	3,353.504	3,355.947
19/12/2011 ~ 18/01/2012	3,242.784	3,242.784
19/01/2012 ~ 18/02/2012	3,082.512	3,078.739
19/02/2012 ~ 18/03/2012	2,840.374	2,840.088
19/03/2012 ~ 18/04/2012	2,724.137	2,724.137
19/04/2012 ~ 18/05/2012	2,930.271	2,930.271
19/05/2012 ~ 18/06/2012	3,078.646	3,078.552
19/06/2012 ~ 18/07/2012	3,085.487	3,085.487
19/07/2012 ~ 18/08/2012	3,541.615	3,541.615
Total	40,672.552	40,670.341
Total rounded down	40,672	40,670

* The values in table of emission reduction are rounded off to four decimal places.

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Decrease of ERs in above table results from some operation events, error in ER calculation ($LFG_{\text{electricity},y}$), measured CH_4 concentration which is measured less than 40% and delayed calibration (Please refer to CAR 2 and CAR 4). Increase of ERs in above table results from error in ER calculation ($w_{CH_4,y}$) (Please refer to CAR 4).

The values of each parameter for ER calculation during this monitoring period in MR (version 01) and in revised MR (version 05) are summarized as follows;

Data verified for ER calculation

Parameter	Value in MR ver. 01	Verified Value (MR ver.05)	Unit/Remark
$LFG_{\text{electricity},y}$	4,719,708.978	4,719,625.000	Nm ³
$w_{CH_4,y}$	52.1370%	52.1348 %	Weight average value during monitoring period
$D_{CH_4,y}$	0.0007168	0.0007168	ton ton/Nm ³ -CH ₄
GWP	21	21	-
$EL_{\text{EXP},PJT,y}$	6,759.616	6,759.616	MWh
$EL_{\text{IMP},PJT,y}$	2.566	2.582	MWh
CEF	0.5375	0.5375	tCO ₂ e/MWh

As required in AMS III. G, $LFG_{\text{electricity},y}$ (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 & CH₄ 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 & CH₄ fraction (Mokpo LFG plant)_date'. Therefore, daily value for $LFG_{\text{electricity},y}$ and weighted average value for $w_{CH_4,y}$ are taken from the raw data sheet of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date' to the spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction' for this entire monitoring period.

The validation team confirmed all data applied to ER calculation in raw data of 'LFG flow rates & CH₄ fraction (Mokpo LFG plant)_date', spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction' and MR are consistent.

Nevertheless, CAR 4 was raised in the course of the verification and was successfully closed (Ref. Annex: Verification Protocol –Table 3).

3.6 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 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 first and second periodic 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 registered PDD version 04, dated 27 November (Revised Monitoring Plan was approved on 19th January 2011) and the applied methodology AMS-I.D(version 13, Grid connected renewable electricity generation), AMS-III.G(version 06, Landfill methane recovery).

KFQ can confirm that:

- The project activity has been implemented and operated as per the registered 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 registered PDD
- The monitoring plan in registered 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.

VERIFICATION AND CERTIFICATION REPORT

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 Approved MP revision dated on 19 January 2011
Methodology applied	AMS-I.D(version 13) AMS-III.G(version 06)
Final version of Monitoring Report	MR version 05 dated 20 November 2012
Crediting period	18 February 2010 ~ 17 February 2020 (fixed)
Monitoring period	18 July 2011 ~ 18 August 2012
Total GHG emission Reductions Verified	Baseline emissions: 40,671.729 tonnes CO ₂ e Project emissions: 1.388 tonnes CO ₂ e Leakage: 0 tonnes CO ₂ e Emission reductions: <u>40,670 tonnes CO₂e</u>

Signed on behalf of the Korean Foundation for Quality

Signature : 

Name : Yu Shim Jeong

Date : 12 December 2012

5 REFERENCES

Reference No.	Documentation and/or website	Remarks
1	<ul style="list-style-type: none"> - Project Design Document of “Mokpo Landfill Gas Recovery Project for Electricity Generation”(UNFCCC Reference No. : 2834), version 02, 23 August 2012 - Revised Monitoring Plan (approved 19th January 2011) 	PDD and MP
2	<ul style="list-style-type: none"> - Final Validation Report, Environmental Management Corporation, Report No. 08-001 (Revision No. 08, 17th February 2010) - Validation report of revised monitoring plan , Korean Foundation for Quality, (Report No. 2010-09, Version NO. 01) - Final Verification report and certification report for 1st monitoring period, Korean Foundation for Quality, (Report No. 2011-03, Version No. 02.3) - Final verification report and certification report for 2st monitoring period, Korean Foundation for Quality, (Report No. 2011-30, Version No. 01.2) 	Report of validation and verification
3	<ul style="list-style-type: none"> - EB 36, AMS-I.D : Grid connected renewable electricity generation (version 13) - EB 38, AMS-III.G : Landfill methane recovery (version 06) - EB 70 annex 3, Validation and Verification Standard (version 03.0) - EB 66 annex 20, Guidelines for completing the monitoring report form (version 02.0) 	Methodology and guidelines
4	<ul style="list-style-type: none"> - Monitoring Report (version 01, 23 August 2012) – for GSC - Monitoring Report (version 05, 20 November 2012) – final - Spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ (version 01.0, 23 August 2012) - Spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ (version 03.0, 11 December 2012) - Raw data sheet of ‘LFG flow rates & CH₄ fraction (Mokpo LFG plant)’ 	Monitoring Report
5	<ul style="list-style-type: none"> - Equipment installation history record by PP (last updated on February 2011) - Permission of electricity generation business, Ministry of Knowledge Economy, last updated on 23 September 2011 - Approval letter for grid connection of the project activity, KPX(1st :5 September 2008 , 2nd : 22 May 2009) - Power Generating Equipment Record for 1st generator, 2nd generator by KESCO - Notification of commercial operation start to local government (Jellanam-do), 18 June 2009 	Evidence for Project implementation
6	<ul style="list-style-type: none"> - Operating Manual – Mokpo LFG Power Plant-Monitoring (Version: 10), 26 September 2011 - Operating Manual – Mokpo LFG Power Plant-Monitoring (Version: 11), 01 December 2011 	Operating Manual

Appendix A. Verification Protocol

7	<ul style="list-style-type: none"> - 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 - Waste generation report and management status , 2008~2011 (generation of 2007 ~ 2010), Ministry of environment, Republic of Korea 	Related evidence for the reason of difference between estimation ER and monitoring result
8	<ul style="list-style-type: none"> - Official Document to explain that power generator's efficiency can be variety from various situation, 18th April 2011, RNP Enterprise Ltd. 	
9	<ul style="list-style-type: none"> - Manual for Gas analyzer, Fuji instrument Korea - Purchase records of Standard Gases using for Gas analyzer Zero/Span test during monitoring period - Reports of Standard Gases Analysis using for Gas analyzer Zero/Span test during monitoring period 	Zero/Span test
10	<ul style="list-style-type: none"> - Bills of electricity imported during monitoring period, KEPCO (Korea Electric Power Corporation) - Daily, Monthly exported electricity record (from KPX website) 	Data source
11	<ul style="list-style-type: none"> - Official document to show the lowest CH₄ concentration required to operate gas engine/generator (40%), 5 September 2012, RNP Enterprise Ltd. - Official document to show that thermal mass flow meter (F_b) can be replaced with thermal mass flow meter (F_c) which same specification, 9 February 2012, Flow Technology Co., Ltd. - Official document to describe that data input and output of monitoring system when thermal mass flow meter (F_b) can be replaced with thermal mass flow meter (F_c), BB system 	Data check during event
12	<ul style="list-style-type: none"> - 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. - Second test report for three meters (2~ 3 April 2012), Flow Technology Co., Ltd. - Initial test report for gas analyzer, 09 April 2009, Fuji Electric Instrumentation Co., Ltd. - Second test report (2 April 2012), 6 April 2012, National Metrology Institute - Initial test report for meter of electricity exported, 28 August 2008, Meter and Petrochemical testing and research Institute - Second test report for meter of electricity exported, 25 August 2010, Korea Testing Certification - Initial test report for meter of electricity imported, 22 August 2008, LG industrial systems Co., Ltd - Second test report for meter of electricity imported, 26 September 2011, Korea Testing Certification 	Measuring equipment calibration report
13	<ul style="list-style-type: none"> - Electric market operation standard, 2008, KPX 	
14	<ul style="list-style-type: none"> - Training plan and records during monitoring plan : External training for electric system operation by KPX during 26 ~ 28 October 2011 External training for electric safety manages by Korea Electric Engineers Association during 22~24 May 2012 Internal training for monitoring during 20 July 2012 	Training

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15	- Daily work log (operation)	
16	- 2011 landfill gas (LFG) facilities operation status, 2012, Ministry of environment, Republic of Korea	

Appendix A. Periodic Verification Protocol

Table 1. Requirement Checklist

Expectations for GHG data management system/controls	Ref.	Verification Comments	Draft. Concl.	Final Concl.
1. Compliance of the monitoring report with the guidance for completing the monitoring report form				
1.1 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 20 of EB66	PP had submitted the monitoring report ver. 1 (dated 23th August 2012) to DOE. The MR has no blank section. This project activity is not a bundled project.	OK	OK
1.2 Description of the project activity 1.2.1 Purpose and general description given in section B.1 below in terms of <ul style="list-style-type: none"> • Purpose of the project activity and the measures taken to reduce greenhouse gas emissions • Brief description of the installed technology and equipments • Relevant dates for the project activity (e.g. construction, commissioning, continued operation records etc) • Total emission reductions achieved in this monitoring period 	Annex 20 of EB66, VVS 228	Yes.	OK	OK
1.2.2 Location of project activity Is complete information of the location of the project activity : town, city, country and GPS coordinates ?	Annex 20 of EB66	Yes.	OK	OK

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1.2.3 Parties and Project participant(s) Are project participants listed ?	Annex 20 of EB66	Yes.	OK	OK
1.2.4 Reference of applied methodology (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 20 of EB66	Yes.	OK	OK
1.2.5 Crediting period of project activity Were the type, start date and length of the crediting period corresponding to this monitoring period provided?	Annex 20 of EB66	Yes.	OK	OK
1.3 Implementation of the project activity 1.3.1 Description of implemented registered project activity 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 20 of EB66, VVS 228	Yes.	OK	OK
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 described. (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?		Yes.	OK	OK

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(d) 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?				
1.3.2 Post registration changes				
1.3.2.1 Temporary deviations from registered monitoring plan or applied methodology Is it indicated whether any temporary deviations have been applied during this monitoring period. In cases, followings are described? <ul style="list-style-type: none"> • 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. • Reason form deviation(s) • How it deviates from the monitoring plan and/or methodology(ies) • The duration for which the deviation(s) is applicable • Justification on the conservativeness of the approach • Approval date, reference number 	Annex 20 of EB66	N/A	OK	OK
1.3.2.2 Corrections Is it indicated any corrections to project information or parameters fixed at validation. In cases, followings are described ? <ul style="list-style-type: none"> • Description of the corrections • Approval date and Reference number • Version number and completion date of the revised PDD 	Annex 20 of EB66	N/A	OK	OK
1.3.2.3 Permanent changes from registered monitoring plan or applied methodology Is it indicated any permanent changes from the registered monitoring plan or applied methodologies. In cases, followings are described? <ul style="list-style-type: none"> • Description of the changes • Approval date and reference number • Version number and the completion date of the revised PDD. 	Annex 20 of EB66	Yes.	OK	OK

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1.3.2.4 Changes to project design of registered project activity Is it indicated any changes to the project design of the project activity. In cases, followings are described? <ul style="list-style-type: none"> • Description of the changes • Approval date and reference number • Version number and the completion date of the revised PDD. 	Annex 20 of EB66	N/A	OK	OK
1.3.2.5 Changes to start date of crediting period Is it indicated any changes to the start date of the crediting period. In cases, followings are described? <ul style="list-style-type: none"> • Description of the changes • Approval date and reference number 	Annex 20 of EB66	N/A	OK	OK
1.4 Description of the monitoring system 1.4.1 Is a description of the monitoring system provided?	Annex 20 of EB66	Yes.	OK	OK
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?		Yes.	OK	OK
1.4.3 Does this include line diagrams showing all relevant monitoring points?		Yes.	OK	OK
1.5 Data and parameters (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 monitored during the monitoring period?	Annex 20 of EB66	Yes.	OK	OK
(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. CO ₂ Emission Intensity of the Electricity displaced (CEF electricity) are described in D.1 (incl. OM and BM).		
(c) For each parameter the following information, using the tables provided, is provided:		Yes.	OK	OK

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(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.		Yes.	OK	OK
(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.	OK	OK
(f) Measuring and recording method: how the parameters are measured/calculated, specifying the measurement and recording frequency?		Yes.	OK	OK
(g) Source of data: logbooks, daily records, surveys, etc?		Yes.	OK	OK
(h) Where relevant, the calculation method of the parameter?		Yes.	OK	OK
(i) The QA/QC procedures applied(if applicable per monitoring plan)?		Yes.	OK	OK
(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?		N/A	OK	OK
1.6 Implementation of sampling plan <i>If applicable, check the completeness in accordance with D.3</i>	Annex 20 of EB66	N/A	OK	OK
1.7 Calculation of emission reductions				
1.7.1 Calculation of baseline emissions				
1.7.1.1 Does this section include sample calculations for all formulae used and calculation of BE applying actual values.	Annex 20 of EB66	Yes.	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.	OK	OK

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1.7.2 Calculation of project emissions 1.5.2.1 Does this section include all formulae used and description to calculate the project emissions applying actual values?	Annex 20 of EB66	Yes.	OK	OK
1.5.2.2 Was a table used and included in this monitoring report or include references to spreadsheet?		Yes.	OK	OK
1.5.3 Leakage calculation 1.5.3.1 Does this section include all formulae used and description to calculate the leakage applying actual values?	Annex 20 of EB66	N/A This project activity has no leakage.	OK	OK
1.5.3.2 Was a table used and included in this monitoring report or include references to spreadsheet?		N/A	OK	OK
1.19 Emission reductions calculation/table 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 20 of EB66	Yes.	OK	OK
1.20 Comparison of actual emission reductions with estimate in the CDM-PDD 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 20 of EB66	Yes.	OK	OK
1.21 Remarks on difference from estimated value in the PDD 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 20 of EB66	Yes.	OK	OK

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2. Project activity implementation				
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 m² and waste disposal area is 180,000 m². 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 on 18 June 2008.</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 third monitoring period under verification. The start date of this monitoring period is 18 July 2011, which is the next day of second monitoring period's end date. The end date of this monitoring period is 18 August 2012 which is within 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 registered PDD and the monitoring plan.</p>	OK	OK
2.2 Are all physical features of this project activity, proposed in the registered PDD, in Place ?	VVS 226	<p>Most physical features of this project activity are in place in accordance with the stipulated information on the registered PDD. But some information is not consistent with PDD as follows:</p> <p><u>The title of the project activity</u> Verification team found the title of the project activity is not consistent with the registered PDD and MR (ver. 01).</p> <ul style="list-style-type: none"> - Registered PDD: Mokpo Landfill Gas Recovery Project for Electricity Generation - MR (ver. 01): Mokpo Landfill Gas Project for Electricity Generation <p><u>Typing error is found in the specification of gas analyzer.</u> The specification of Gas analyzer as Linearity and Zero drift is not consistent with PDD. (PDD: Linearity +/- 0.5%, Zero drift +/- 1%, Manufacturer's manual: Linearity +/- 1%, Zero drift +/- 2%)</p>	CAR 1, CAR 2, CL 1	OK

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		<p>From the evidence submitted to DOE during validation, “Quotation of gas analyzer system, Dated 13 March 2009” (verification team received the evidence from the validation DOE, KECO), and the Fuji instrument company confirmation letter show there is no product Fuji instrument Korea having the specification in PDD. Even this issue was verified in initial verification, the verification team checked relevant document again and confirmed that the figures in PDD is just typing error.</p> <p><u>Specification of LFG collection system, pre-treatment, engine, and generator</u></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 156. Each well head has been connected to the 12 vertical wells and there are 13 wellheads on the project site. At the time of validation, the ER was calculated under assumption of 100% of generated LFG is recovered and it was in accordance with the Model introduced by IPCC. Well number change contributes recovery efficiency but the recovery efficiency can't exceed 100%. Thus regarding to this change, verification team concluded this change was not occurred intentionally as it does not influence on ER and this increasing also does not effect to the additionality of this project activity.</p> <p>Verification team found that during physical site inspection some operation events during this monitoring period were omitted (e. g. Temporary black out, Reset of the flow meter etc.) and the duration of some operation events in MR (ver. 01) were not consistent with source data (e.g. 10/08/2011, 24/01/2012, 13/02/2012)</p>		
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 registered 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 registered PDD and approved revised PDD.	OK	OK

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2.5 Was an on-site visit conducted?	VVS 226	<p>Yes. On-site assessment was conducted on 11 September 2012. The audit purpose and methodology was briefed in the opening meeting participated by the following persons:</p> <p><u>Korean Foundation for Quality</u></p> <ul style="list-style-type: none"> - Sang Yeon PARK (audit team leader, auditor) - Mi Jung LEE (audit team member, auditor) - Kyoung Ae PARK (audit team member, Observer) <p><u>Hanwha Corporation (Project owner)</u></p> <ul style="list-style-type: none"> - Kun Hong LEE - Hae yung YANG <p><u>Econetwork Co., Ltd. (Consulting company)</u></p> <ul style="list-style-type: none"> - Hyeon Gu HA - Eu Ddeum PARK 	OK	OK
2.6 If not, justify the rationale of the decision.	VVS 226/ 227	N/A	OK	OK
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	There is no requesting for deviation and notifying and requesting approval of changes in the implementation or operation of the project activity in this monitoring period.	OK	OK
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 previous verification, MP revision had been requested at 15 th September 2010 and it is approved on 19 January 2011. In this monitoring period, the revised MP was applied.	OK	OK
3. Compliance of the monitoring plan with the monitoring methodology and applicable tool(s)				
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 complied with the approved methodology, AMS-I.D (ver. 13) and AMS-III.G (ver. 06).	OK	OK
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	VVS 251, 252,	N/A	OK	OK

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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.	262, 263, 265			
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	OK	OK
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	OK	OK
4. Compliance of monitoring with the monitoring plan				
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	Yes, the monitoring of reductions in GHG emissions to result from the project activity is implemented in accordance with the revised MP (approved on 19 January 2011).	OK	OK
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	There is no requesting for deviation and notifying and requesting approval of changes in the implementation or operation of the project activity in this monitoring period. In previous verification, MP revision had been requested at 15 th September 2010 and it is approved on 19 January 2011. In this monitoring period, the revised MP was applied. The verification team confirmed that the revised monitoring plan is in line with the monitoring methodology (AMS-III.G ver. 06, AMS-I.D ver. 13) and paragraph 57 of the modalities and procedures for the CDM. And the revised MP is not reduced the level of accuracy and completeness in the monitoring and verification process and there will be no impact in the emission reduction calculations.	OK	OK

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4.3 Has the monitoring plan been properly implemented and followed by the project participants?	VVS 234(a)	Please refer to 4.1.	OK	OK
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.	OK	OK
4.4.1 Project emission parameters?	VVS 234(b)	<p>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 ($EL_{IMP,PJT,y}$).</p> <p>To monitor imported electricity, one (1) watt-hour meter is installed (tag : W_b).</p> <p>The amount of imported electricity are measured automatically by certified watt-hour meter and got from the bill issued by KEPCO.</p>	OK	OK
4.4.2 Baseline emission parameters?	VVS 234(b)	<p>Major parameters for baseline were $LFG_{electricity,y}$, $W_{CH4,y}$, $EL_{EXP,PJT,y}$. These were consistent with the revised monitoring plan.</p> <p>The description of meters for parameters are as below;</p> <p><u>LFG flow meters for $LFG_{electricity,y}$</u></p> <p>Three flow meters were installed for measuring amount of LFG combusted in power plant ($LFG_{electricity,y}$). Two flow meters (Tag : F_b, (for generator 1), F_c (for generator 2)) were located in front of each power generation and used for direct measuring the amount of LFG combusted in power plant ($LFG_{electricity,y}$). Total amount of landfill gas combusted in power plant is the sum of value measured from F_b, and F_c. Thus, $LFG_{electricity,y}$ was monitored with F_b and F_c and $LFG_{electricity,y}$ in the spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction' have been verified against the data from centralized monitoring system during the on-site visit.</p> <p>And the other flow meter (Tag : F_a (total flow meter)) was located in front of the branch of pipeline to each power generator and the measured value from F_a was used for cross check.</p> <p>Amount of landfill gas combusted in power plant is measured by gas flow meters and the data is got from centralized monitoring system</p>	OK	OK

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		<p>data server.</p> <p><u>Gas analyzer for $W_{CH_4,y}$</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.</p> <p><u>Watt-hour meter for $EL_{EXP,PJT,y}$</u> To monitor exported electricity, one (1) watt-hour meter is installed (tag : W_a). The amount of exported electricity are measured automatically by certified watt-hour meter and got from KPX website (E-power market).</p>		
4.4.3 Leakage parameters?	VVS 234(b)	N/A	OK	OK
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.11) of project entity. There is no contradiction between both documents as well as real situation</p>	OK	OK

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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)	Meters for electricity imported from the Grid EL _{IMP,PJT,Y} is measured with watt-hour meter. The calibration frequency for this meter is 2 years. The 2nd calibration was occurred on 26 September 2011. The calibration was performed by Korea Testing Certification, 3 rd party. The verification team checked that the delayed calibration period was occurred between the previous calibration (22 August 2008) and the latest calibration date.	CAR 4, CL 2																																												
		<table><tr><td colspan="2">Description</td><td colspan="2">Amount of imported electricity</td></tr><tr><td colspan="2">Applied parameter</td><td colspan="2">EL_{IMP,PJT,Y}</td></tr><tr><td colspan="2">Tag</td><td colspan="2">W_b</td></tr><tr><td colspan="2">Serial No.</td><td colspan="2">0190662</td></tr><tr><td colspan="2">Accuracy level</td><td colspan="2">1s</td></tr><tr><td colspan="2">Installation date</td><td colspan="2">01-06-2009</td></tr><tr><td rowspan="3">Initial test</td><td>Testing</td><td colspan="2">22-08-2008</td></tr><tr><td>Validity</td><td colspan="2">21-08-2010</td></tr><tr><td>Calibration Entity</td><td colspan="2">LS industrial Co., Ltd.</td></tr><tr><td rowspan="3">Second test</td><td>Testing</td><td colspan="2">27-09-2011</td></tr><tr><td>Validity</td><td colspan="2">26-09-2013</td></tr><tr><td>Calibration Entity</td><td colspan="2">Korea Testing Certification (KTC)</td></tr></table>		Description		Amount of imported electricity		Applied parameter		EL _{IMP,PJT,Y}		Tag		W _b		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		Calibration Entity	Korea Testing Certification (KTC)	
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Gas flow meters LFG _{electricity,y} is measured by gas flow meter. The flow meter is calibrated every three years. The 2 nd calibration was occurred on 02 April 2012 and performed by Flow Technology Co., Ltd., 3 rd party.																																															
<table><tr><td colspan="2">Description</td><td colspan="3">Amount of landfill gas combusted in power plant</td></tr><tr><td colspan="2">Applied parameter</td><td>LFG_{electricity,y}</td><td>LFG_{electricity,y}</td><td>LFG_{electricity,y}</td></tr><tr><td colspan="2">Type</td><td colspan="3">Thermal mass flow meter</td></tr><tr><td colspan="2">Tag</td><td>F_a (Total)</td><td>F_b (1st generator)</td><td>F_c (2nd generator)</td></tr><tr><td colspan="2">Serial No.</td><td>906044B</td><td>812003</td><td>906044A</td></tr><tr><td colspan="2">Accuracy level</td><td>1%</td><td>1%</td><td>1%</td></tr><tr><td colspan="2">Installation date</td><td>27-07-2009</td><td>27-07-2009</td><td>20-05-2009</td></tr><tr><td>Initial test</td><td>Testing (Reporting)</td><td>24-07-2009 (2009-06-</td><td>18-03-2009 (2008-12-</td><td>24-07-2009 (2009-06-</td></tr></table>		Description		Amount of landfill gas combusted in power plant			Applied parameter		LFG _{electricity,y}	LFG _{electricity,y}	LFG _{electricity,y}	Type		Thermal mass flow meter			Tag		F _a (Total)	F _b (1 st generator)	F _c (2 nd 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-	18-03-2009 (2008-12-	24-07-2009 (2009-06-						
Description		Amount of landfill gas combusted in power plant																																													
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Tag		F _a (Total)	F _b (1 st generator)	F _c (2 nd generator)																																											
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Initial test	Testing (Reporting)	24-07-2009 (2009-06-	18-03-2009 (2008-12-	24-07-2009 (2009-06-																																											

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				31)	03)	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.														
		<p>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.</p> <p>The verification team found that the flow meter (F_b) for measuring the 1st generator was replaced with the flow meter (F_c) during 13/02/2012 ~ 15/03/2012.</p> <p>As for this, please clearly explain the reason and indicate its information for the monitoring parameter ‘LFG_{electricity, y}’ in the MR.</p> <p><u>Gas analyzer</u></p> <p>W_{CH4,y} is measured by gas analyzer. The gas analyzer is calibrated every three years and performed by National Metrology Institute, 3rd party.</p> <table><tr><td>Description</td><td>Methane fraction in LFG</td></tr><tr><td>Applied parameter</td><td>W_{CH4,y}</td></tr><tr><td>Type</td><td>Methane analyzer</td></tr><tr><td>Tag</td><td>G</td></tr><tr><td>Serial No.</td><td>A8M7282T</td></tr><tr><td>Accuracy level</td><td>Linearity 1%, Repeatability 0.5%</td></tr></table>							Description	Methane fraction in LFG	Applied parameter	W _{CH4,y}	Type	Methane analyzer	Tag	G	Serial No.	A8M7282T
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		Measurable gas components and measuring range		Minimum range	Maximum range	
			CO ₂	0 ~ 500 ppm	0 ~ 100vol%	
			CH ₄	0 ~ 1,000 ppm	0 ~ 100vol%	
			O ₂ (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	National Metrology Institute		
		<p>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 CH₄ 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.</p> <p>W_{CH4} maintenance and testing method (Zero/Span test) is not in accordance with the manufacturer's manual (The manual required every week testing but PP did monthly testing)</p> <p>PP applied conservative CH₄ concentration (40%) for BE calculation when pipeline connected to methane analyzer was frozen. Please justify applying conservative CH₄ concentration (40%) to BE calculation.</p> <p><u>Meters for electricity exported to the Grid</u> EL_{EXP,PJT,y} is measured with watt-hour meter. The calibration</p>				

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		<div>frequency for this meter is 2 years. The 2nd calibration was occurred on 25 August 2010. The calibration was performed by Korea Testing Certification, 3rd party.</div> <table><tr><td colspan="2">Description</td><td>Amount of exported electricity</td></tr><tr><td colspan="2">Applied parameter</td><td>$EL_{EXP,PJT,y}$</td></tr><tr><td colspan="2">Tag</td><td>W_a</td></tr><tr><td colspan="2">Serial No.</td><td>95246742</td></tr><tr><td colspan="2">Accuracy level</td><td>0.5s</td></tr><tr><td colspan="2">Installation date</td><td>06-09-2008</td></tr><tr><td rowspan="3">Initial Test</td><td>Testing</td><td>28-08-2008</td></tr><tr><td>Validity</td><td>27-08-2010</td></tr><tr><td>Calibration Entity</td><td>Meter and Petrochemical testing and research Institute.</td></tr><tr><td rowspan="3">Second Test</td><td>Testing</td><td>25-08-2010</td></tr><tr><td>Validity</td><td>24-08-2012</td></tr><tr><td>Calibration Entity</td><td>Korea Testing Certification.</td></tr></table>	Description		Amount of exported electricity	Applied parameter		$EL_{EXP,PJT,y}$	Tag		W_a	Serial No.		95246742	Accuracy level		0.5s	Installation date		06-09-2008	Initial Test	Testing	28-08-2008	Validity	27-08-2010	Calibration Entity	Meter and Petrochemical testing and research Institute.	Second Test	Testing	25-08-2010	Validity	24-08-2012	Calibration Entity	Korea Testing Certification.		
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4.6 Are monitoring results consistently recorded as per approved frequency?	VVS 234(d)	<div>According to the monitoring plan in the registered PDD, treated LFG flow meter ($LFG_{electricity,y}$), CH_4 concentration in LFG ($W_{CH4,y}$) are automatically measured continuously and recorded in electric file. Electricity exported to the grid by the project ($EG_{EXP,PJT}$) and electricity imported from the Grid ($EG_{IMP,PJT}$) are measured hourly and recorded monthly which is in compliance with the registered PDD.</div> <div>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.</div>	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																																
5. Compliance with the calibration frequency requirements for measuring instruments																																				

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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	As for the calibration of watt-hour meter for imported electricity, the verification team checked that the delayed calibration period was occurred between the previous calibration and the latest calibration date (22/08/2010 ~ 26/09/2011). Regarding this, please take measure according to the ‘ Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)’.	CAR 3	
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	As for the calibration of watt-hour meter for imported electricity, the verification team checked that the delayed calibration period was occurred between the previous calibration and the latest calibration date (22/08/2010 ~ 26/09/2011). Regarding this, please take measure according to the ‘ Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)’.	CAR 3	
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	As for the calibration of watt-hour meter for imported electricity, the verification team checked that the delayed calibration period was occurred between the previous calibration and the latest calibration date (22/08/2010 ~ 26/09/2011). Regarding this, please take measure according to the ‘Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)’.	CAR 3	
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 registration changes in section of E of the VVSt and appendix 1 of the project standard.	VVS 241	N/A	OK	OK
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 Gird has	CAR 3	

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		<p>been calibrated every 2 years. However calibration of meter for electricity imported to the Grid was delayed in 2010.</p> <p>The verification team checked that the delayed calibration period was occurred between the previous calibration and the latest calibration date (22/08/2010 ~ 26/09/2011).</p> <p>Regarding this, please take measure according to the 'Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)'.</p>		
6. Assessment of data and calculation of greenhouse gas emission reductions				
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.	OK	OK
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"> - Flow meters data record - Gas analyzer data record - Daily, monthly exported electricity record from KPX website - Bills for imported electricity issued by KEPCO - Daily work log (operation) - Spread sheet ' Mokpo_3rd MR_R2834_Emission Reduction' <p>During site visit, the verification team reviewed raw data and ERs calculation for operation event. There are some error in data and ERs calculation as follows;</p> <ul style="list-style-type: none"> - LFG_{electricity,y} : some error in raw data on 5 August 2011, 3 February 2012, 15 March 2012 and 18 March 2012. - weighted average CH₄ : some error in raw data on 20 and 28 November 2011 	CAR 4, CL 1	

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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 $Fa = Fb + Fc$. And the daily accumulated flow data crosschecked with Daily record.</p> <p>Also, for confirmation of amount of $EG_{EXP, PJT}$ which are quantity of electricity exported to grid, verification team checked data of electricity exported to grid in KPX website (http://www.kpx.or.kr).</p>	OK	OK
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.	OK	OK
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.	OK	OK
6.6 Have appropriate emission factors, IPCC default values and other reference values been correctly applied?	VVS 245(e)	<p>According to the registered PDD, PP determined to use ex-ante emission factor (CEF: 0.5375 t CO₂e/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_{CH_4}(21 tCO₂e/tCH₄) are correctly applied during monitoring period through checking related documents and site inspection.</p> <p>For the density of CH₄ under STP (Standard temperature and pressure) the value of 0.0007168 kg/Nm³ was applied to BE calculation. The source of this value is ACM0001 (ver.11) and the verification team identified the density of CH₄ are correctly applied during monitoring period through checking the ACM0001 (ver.11) and spread sheet of 'Mokpo_3rd MR_R2834_Emission Reduction'.</p>	OK	OK

Table 2. GHG data management system/controls			
GHG data management system/controls	Score	Verification Comments	Remarks
1. Define organizational structure, responsibilities and competencies			
1.1 Position and roles 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.		PP indicates position and role in section 2 of the monitoring manual (ver 11. dated 1/12/2011) and the verification team interviewed some of staffs on the project site to confirm implementation of this manual. - CDM team director in head quarter : 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	OK
1.2 Responsibilities Specific monitoring and reporting tasks and responsibilities are included in job descriptions or special instructions for employees.		Overall responsibility for operation, maintain of facilities, monitoring and reporting of the project is charged by CDM team manager in head quarter and it is well indicated in the monitoring manual. And Specific tasks are also well described in the in the 'monitoring manual'.	OK
1.3 Competencies needed Competencies needed for each aspect of the GHG determination process are analyzed. Personnel competencies are assessed and training programme implemented as required,		To meet competency needed for carry out GHG determination process, CDM monitoring training was conducted toward those person who involved in the GHG determination process - External training for electric system operation by KPX during 26 ~ 28 October 2011 - External training for electric safety manages by Korea Electric Engineers Association during 22~24 May 2012 - Internal training for monitoring during 20 July 2012 : Introduction on the general information and scheme of CDM : The requirement for CDM	OK

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		After interview with those personnel who attended in the training, the verification team could confirm that staffs know where those collected data are used and that accuracy should be ensured.	
2. GHG data management system and controls			
2.1 Information/process flow An information/process flow diagram, describing the entire process from raw data to reported totals is developed.		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 in the operating manual and it is consistent with monitoring plan in the registered PDD (revised monitoring plan).	OK
2.2 Data transfer 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.		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.	OK
2.3 Data trails Requirements for documented data trails are defined and implemented and all documentation are physically available.		According to the data management procedure in the operating manual, 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 operating manual and Monitoring plan in PDD to keep the data and related documents until two years after the end of the crediting period. 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 operating manual.	OK
2.4 Guidance on checks and reviews 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		According to the operating manual, CDM team manager in head quarter (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. Consequently, CDM team manager in head quarter has responsibility to update the monitoring plan and manual accordingly if the monitoring system need to change on the project site and raising the follow-up of corrective actions after a third party	OK

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calculation processes.		verification. Verification team confirms above system have been implemented with related documents and staff interview.	
2.5 Internal verification Internal verifications include the GHG data management systems, to ensure consistent application of calculation methods.		Emission reduction calculation and compilation of monitoring report is prepared by person in charge of CDM in head quarter. Thus it is believed calculation methods can be applied consistently.	OK
2.6 Internal validation 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.		Weekly measured data was reported to person in charge of CDM in head quarter. Internal audit for management of monitoring data is annually carried out by internal auditor who is appointed by person in charge of CDM in head quarter. 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.	OK
2.7 Data protection measures Data protection measures for databases/spreadsheets should be in place (access restrictions and editor rights).		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 ³ /h), CH ₄ 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.	OK

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																																								
CAR 1 : The title of the project activity is not consistent with the registered PDD and MR (ver.1).	2.2	PP changed the title of the project activity in MR to ‘Mokpo Landfill Gas Recovery Project for Electricity Generation’.	O.K.																																								
CAR 2: During on-site visit, some operation events were found. (e. g. Temporary black out, Reset of the flow meter etc.) Please describe these omitted events including the way of data processing during the monitoring period in MR (ver.1) and clearly remark it in the data source.	2.2	<p><Table 8-1> ‘History of operation event’ in MR was revised to add omitted operation events in the table. During this monitoring period, operation event is as follow.</p> <table border="1"> <thead> <tr> <th>Date</th><th>Duration</th><th>Operation events</th><th>Note</th></tr> </thead> <tbody> <tr> <td>22/07/2011</td><td>0.5 hours (14:10~14:36)</td><td>The entire project boundary was blacked out. Power transmission (Import/Export) stopped.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>05/08/2011</td><td>0.5 hours (14:23~14:44)</td><td>The entire project boundary was blacked out. Power transmission (Import/Export) stopped.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>10/08/2011</td><td>11.5 hours (08:36~19:47)</td><td>Maintenance of generator.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>12/08/2011</td><td>6 hours (09:42~15:39)</td><td>Maintenance of generator.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>16/08/2011</td><td>6 hours (05:05~10:51)</td><td>Maintenance of generator.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>07/09/2011</td><td>2 hours (15:00~16:57)</td><td>Maintenance of monitoring system.</td><td>Keep an hourly work log on the flow rate and CH₄ concentration.</td></tr> <tr> <td>10/09/2011</td><td>0.5 hours (18:12~18:41)</td><td>Maintenance of pressure valve.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>15/09/2011</td><td>5.5 hours (16:06~21:19)</td><td>The entire project boundary was blacked out. Power transmission (Import/Export) stopped.</td><td>Excluded for estimation of emission reduction.</td></tr> <tr> <td>21/10/2011</td><td>0.5 hours</td><td>The entire project boundary was</td><td>Excluded for estimation of</td></tr> </tbody> </table>	Date	Duration	Operation events	Note	22/07/2011	0.5 hours (14:10~14:36)	The entire project boundary was blacked out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.	05/08/2011	0.5 hours (14:23~14:44)	The entire project boundary was blacked out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.	10/08/2011	11.5 hours (08:36~19:47)	Maintenance of generator.	Excluded for estimation of emission reduction.	12/08/2011	6 hours (09:42~15:39)	Maintenance of generator.	Excluded for estimation of emission reduction.	16/08/2011	6 hours (05:05~10:51)	Maintenance of generator.	Excluded for estimation of emission reduction.	07/09/2011	2 hours (15:00~16:57)	Maintenance of monitoring system.	Keep an hourly work log on the flow rate and CH ₄ concentration.	10/09/2011	0.5 hours (18:12~18:41)	Maintenance of pressure valve.	Excluded for estimation of emission reduction.	15/09/2011	5.5 hours (16:06~21:19)	The entire project boundary was blacked out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.	21/10/2011	0.5 hours	The entire project boundary was	Excluded for estimation of	O.K.
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			(16:24~16:42)	black out. Power transmission (Import/Export) stopped.	emission reduction.
			1.5 hours (17:22~18:32)	The Monitoring system was black out.	Keep an hourly work log on the flow rate and CH ₄ concentration.
		25/10/2011 ~ 26/10/2011	16 hours (21:12~11:52)	The entire project boundary was black out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.
		14/12/2011	4 hours (05:35~09:24)	The entire project boundary was black out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.
		24/01/2012	1.5 hours (09:54~11:17)	Pipeline to methane analyzer was frozen.	Excluded for estimation of emission reduction.
		03/02/2012	1 hours (08:00~08:53)	The entire project boundary was black out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.
		13/02/2012	2 hours (10:03~12:10)	Replaced the flow meter for calibration.	Excluded for estimation of emission reduction.
		24/02/2012	2.5 hours (20:58~23:29)	The entire project boundary was black out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.
		15/03/2012	1 hour (13:11~14:18)	Maintenance of flow meter.	Excluded for estimation of emission reduction.
		18/03/2012	1.5 hour (16:28~17:53)	Replaced the flow meter for calibration.	Excluded for estimation of emission reduction.
		31/03/2012 ~ 01/04/2012	34 hours (08:09~18:00)	Maintenance of landfill site.	Excluded for estimation of emission reduction.
		01/04/2012 ~ 04/04/2012	65 hours (18:00~11:02)	Calibration of two flow meters.	Excluded for estimation of avoidance methane emission reduction.
		10/04/2012	1 hours (13:15~14:14)	Maintenance of generator.	Excluded for estimation of emission reduction.
		18/06/2012	0.5 hours (20:59~21:24)	Errors of generator system.	Excluded for estimation of emission reduction.
		22/07/2012	2.5 hours (08:48~11:04)	The entire project boundary was black out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.

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		03/08/2012	5.5 hours (08:01~13:34)	The entire project boundary was blacked out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.	
		13/08/2012	0.5 hours (11:13~11:20)	The entire project boundary was blacked out. Power transmission (Import/Export) stopped.	Excluded for estimation of emission reduction.	
CAR 3: As for the calibration of watt-hour meter for imported electricity, the verification team checked that the delayed calibration period was occurred between the previous calibration and the latest calibration date. Regarding this, please take measure according to the 'Guidelines for assessing compliance with the calibration frequency requirements (EB52/Annex 60)'.	5.1 ~ 5.5	According to the approved revised monitoring plan, PP decided to adopt two (2) years of calibration frequency and accuracy level of this meters are 1s. The verification team reviewed initial test report (22 August 2008) issued by LS industrial Co., Ltd. and second test report (27 September 2011) issued by KTC and found delayed calibration (18 July 2011 ~ 26 September 2011) during this monitoring. The result of second test implemented on 27 September 2011 was smaller than the maximum permissible error. Because the second calibration was delayed, the data of imported electricity was corrected applying the maximum permissible error of watt-hour meter according to "CDM VVS (version 03.0)" during 18 July 2011 ~ 18 October 2011 as a conservative manner. Actually the validity of latest calibration is from 27 September 2011 but the correction period (27 September 2011 ~ 18 October 2011) is decided considering electricity use period in the bill (19 previous month ~ 18 current month). PP applied 1.5% for correction of the data as a conservative manner even though 1 % (the maximum permissible error of the used watt hour meter during this monitoring period) was required.				O.K.

Appendix A. Verification Protocol

<p>CAR 4</p> <p>According to VVS, para. 244, the DOE shall assess the data and calculation of GHG emission reductions achieved by/resulting from the project activity by application of the selected approved methodology. During site visit, the verification team reviewed raw data and ERs calculation for operation event.</p> <p>1) There are some error in data and ERs calculation.</p> <ul style="list-style-type: none"> - LFG_{electricity,y} : some error in raw data on 5 August 2011, 3 February 2012, 15 March 2012 and 18 March 2012. - weighted average CH₄ : some error in raw data on 20 and 28 November 2011 <p>2) PO applied conservative CH₄ concentration (40%) for BE calculation when pipeline connected to methane analyzer was frozen on 24 January 2012. Please justify applying conservative CH₄ concentration (40%) to BE calculation.</p>		<p>PO revised the data and calculation of ERs achieved by the project activity. LFG_{electricity,y} on 5 August 2011, 3 February 2012, 15 March 2012 were decreased and 18 March 2012 and “weighted average CH₄” on 20 and 28 November 2011 were increased.</p> <p>CH₄ concentration was not measured during two hours as pipeline connected to gas analyzer was frozen on 24 January 2012. PP applied CH₄ concentration of ‘0%’ to BE calculation in a conservative manner as they don’t know CH₄ concentration at the time.</p> <p>Meanwhile, according to the manufacture’s opinion for the normal operation condition of gas turbine generator used LFG, the 40% of CH₄ concentration is required for normal operation. (It is identified with the official document provided by the gas turbine engine generator supply company, RNP Enterprise Ltd.). Thus, if CH₄ concentration was measured under 40%, it can be though to be the gas turbine generator is on abnormal operation. Therefore, PP also regarded measured CH₄ concentration under 40% as ‘0%’ for BE calculation in a conservative manner.</p> <p>As a result, LFG_{electricity,y} and w_{CH₄,y} for ERs calculation is 4,719,625.000 Nm³ and 52.1348 % respectively which is lower than value in PDD GSC (4719,708.978 Nm³ and 52.1370%).</p>	<p>OK</p>
<p>CL 1:</p> <p>The duration of some operation events in MR (ver.1) were not consistent with source data. e.g. 2011/08/10, 2012/01/24, 2012/02/13</p>	<p>2.2, 6.2</p>	<p><Table 8-1> ‘History of operation event’ in MR was revised.</p>	<p>O.K.</p>

Appendix A. Verification Protocol

<p>CL 2:</p> <p>The verification team found that the flow meter (F_b) for measuring the 1st generator was replaced with the flow meter (F_c) for measuring the 2nd generator since 13/02/2012.</p> <p>As for this, please clearly explain the reason and indicate its information for the monitoring parameter ‘ LFG electricity, y’ in the MR.</p>	<p>4.5</p>	<p>For calibration of flow meter installed at 1st generator (F_b –SN:812003), it was detached from 1st generator during 13 February 2012 ~ 3 April 2012. The validation team found two generators are not operated at the same time at site inspection and confirmed it through measured LFG_{electricity,y} (Nm³) in raw data. So, meter of SN:906044A was replaced and used for F_b to measure flow data of LFG combusted in 1st generator during 13 February ~ 18 March 2012. The measuring value during this period is indicated in column of F_c in the spread sheet of ‘Mokpo_3rd MR_R2834_Emission Reduction’ ver. 03.0. Meter of SN:906044A was attached to 2nd generator (F_c) again to measure flow data of LFG combusted in 2nd generator on 18 March 2012. After calibration, the meter of SN:812003 was reattached on 1st generator (F_b) on 3 April 2012. Thus, the verification team confirmed flow data was not measured by the meter installed at F_b during 18 March 2012 ~ 1 April 2012. The verification team also confirmed replacement of flow meter installed at F_b through daily work log.</p> <p>Furthermore, the verification team made sure F_b can be replaced with F_c to measure amount of landfill gas combusted in power plant through official documents regarding to compatability of meter spec and monitoring system issued by manufacturer (Flow Technology Co., Ltd.) and data server maintenance company (BB system) respectively.</p>	<p>O.K.</p>
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Appendix B
Qualification of Verification Team



CERTIFICATE OF COMPETENCE

Name: Sang Yeon PARK

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
- 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 19 December 2011.

Sustainability Management Institute
Nam Hoon KIM

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



CERTIFICATE OF COMPETENCE

Name: Mi Jung LEE

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

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 28 February 2011.

Sustainability Management Institute
Byung Yong LEE

A handwritten signature in black ink, appearing to read 'B Y Lee'.

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', is written over a faint, light-colored circular stamp.