




**Verification and certification report form for  
CDM project activities  
(Version 02.1)**

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

**BASIC INFORMATION**

<b>Title and UNFCCC reference number of the project activity</b>	LG Chem Naju plant fuel switching project (Ref. 2475)
<b>Version number of the verification and certification report</b>	Version 2.0
<b>Completion date of the verification and certification report</b>	16/04/2018
<b>Monitoring period number and duration of this monitoring period</b>	2 <sup>nd</sup> monitoring period, 24/02/2011~ 31/10/2016
<b>Version number of the monitoring report to which this report applies</b>	3.0
<b>Crediting period of the project activity corresponding to this monitoring period</b>	04/06/2009 to 03/06/2019(Fixed 10 year)
<b>Project participants</b>	LG Chem, Ltd.
<b>Host Party</b>	Republic of Korea
<b>Applied methodologies and standardized baselines</b>	AMS-III.B. Switching fossil fuel (version 12.0)
<b>Mandatory sectoral scopes linked to the applied methodologies</b>	Sectoral scope 1 - Energy Industries (Renewable-/non-renewable sources)
<b>Conditional sectoral scope(s) linked to the applied methodologies</b>	N/A
<b>Estimated amount of GHG emission reductions or GHG removals for this monitoring duration in the registered PDD</b>	111,632 tCO <sub>2eq</sub>
<b>Certified amount of GHG emission reductions or GHG removals for this monitoring period</b>	80,861 tCO <sub>2eq</sub>
<b>Name and UNFCCC reference number of the DOE</b>	Korean Standards Association (KSA) / E-0039
<b>Name, position and signature of the approver of the verification and certification report</b>	JinSeong, Park Director General of Certification Division 

**SECTION A. Executive summary**

>>Korean Standards Association (KSA) has been commissioned by LG Chem, Ltd. (hereafter the PP) to carry out the verification of emission reductions reported from "LG Chem Naju plant fuel switching project" by LG Chem, Ltd." (Reference No. 2475) in the Republic of Korea (hereafter the project activity) for the 2<sup>nd</sup> monitoring period from 24/02/2011 to 31/10/2016.

This verification is based on the draft Monitoring Report (ver.1.0, dated on 21/05/2017), the final Monitoring Report (ver. 3.0, dated on 02/03/2018), the applied monitoring methodology (AMS-III.B.: Switching fossil fuels, version 12.0), monitoring plan as described in the revised monitoring plan and the registered PDD, Validation Report, emission calculation spreadsheet and supporting documents made available to KSA by the project participants.

In KSA's opinion, the reported GHG emission reduction for the period from 24/02/2011 to 31/10/2016, as reported in the Monitoring Report (version 03, 02/03/2018) for the project, are fairly stated.

The GHG emission reductions were correctly calculated without material misstatements on the basis of the approved monitoring methodology AMS-III.B (Version 12.0), the revised monitoring plan and formulae given in the registered PDD. The project was registered as a CDM project on 04/06/2009 under UNFCCC with the registration number 2475.

Korean Standards Association (KSA) is able to certify that the project has achieved emission reductions during the monitoring period mentioned above, amount 80,861 tons of tCO<sub>2</sub> equivalent.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified. The verification has based on the requirements in the Validation and Verification Standard for project activities (VVS) version 1.0, and employed a risk-based approach, focusing on the identification of significant reporting risks.

As a result of verification activity, KSA confirms that claimed emission reduction 80,861 tCO<sub>2</sub>e for 2<sup>nd</sup> monitoring period (24/02/2011 to 31/10/2016) is correctly calculated on the basis of approved applied methodology AMS-III.B version 12.0, the revised monitoring plan and formulae given in the revised monitoring plan and registered PDD.

**SECTION B. Verification team, technical reviewer and approver****B.1. Verification team member**

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk/document review	On-site inspection	Interviews	Verification findings
1.	Team Leader	OR	Sohn	Kyull	KSA	V	V	V	V
2.	Team Member	OR	Han	WonCheol	KSA	V	V	V	V
3.	Trainee	IR	Moon	HyunMan	KSA	V	V	V	V

**B.2. Technical reviewer and approver of the verification and certification report**

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical reviewer	OR	Choi	SeungKeun	KSA
2.	Approver	IR	Park	JinSeong	KSA

**SECTION C. Application of materiality****C.1. Consideration of materiality in planning the verification**

No.	Risk that could lead to material errors, omissions or misstatements	Assessment of the risk		Response to the risk in the verification plan and/or sampling plan
		Risk level	Justification	
1.	Human error in the quantification of emissions	L	It is likely to occur when personnel are unfamiliar with or not well trained regarding, emissions process or data recording.	1) Documents review - the registered PDD and validation report - the previous verification report including 1 <sup>st</sup> monitoring report 2) personnel experience/ training - Request the senior's review - Consultant participation
2	Design of data control	L	Use of spreadsheets without adequate controls related to data changes/ updates, version tracking, traceability security.	1) Check the activity data - LNG consumptions - Purge gas consumption - By-product liquid - steam generated by the project boiler 2) Check the activity data applied to spread sheet and the function formula
3	Omissions and misstatements in data transfer from hand written into digital Excel ER spreadsheet	M	Ineffective quality control of data transfer due to unclear QA/QC procedure.	1) All data are recorded electronically to LG Chem, Ltd. 2) Check boiler efficiency which are hand written note. 3) Be careful about the activity data into the emission reductions spreadsheet.
4	Missing data due to failure of measurement equipment	L	The monitoring plan defines emergency procedures in case a meter fails. No back-up meters are installed or available onsite.	Data collection effort throughout the crediting period (QA/QC) as below; 1) Eligibility verification 2) Measuring device malfunction 3) Review the heat balance 4) Database

**C.2. Consideration of materiality in conducting the verification**

>> As per the "para 329 of VVS version 1.0"<sup>11/</sup>, the project activity is a small-scale CDM project activity achieving total emission reduction or removals, as such a 5.0 percent materiality threshold is applied.

At the beginning of the verification, the verification team have assessed the nature, scale and complexity of the project activity by carrying out a strategic analysis of all activities relevant to the project activity.

The verification was basically carried out as per the verification plan. However, based on the actual situation on-site and the errors, omissions and misstatements identified during the verification minor deviations from the original plan occurred. However, due to the insignificance no major revision of the overall plan was required, especially there are no need for additional/less location to be visited during the on-site.

## **SECTION D. Means of verification**

### **D.1. Desk/document review**

>> The verification of the project documentation provided by the project participant is based upon both quantitative and qualitative information on emission reductions. Quantitative information comprises the reported numbers in the initial version of Monitoring Report<sup>/01/</sup> submitted to the KSA.

Qualitative information comprises information on internal management system, emissions reduction calculation procedure, procedures for transfer of data, frequency of emission reports and review and internal quality control. The monitoring report submitted by the project participant was also made available on the UNFCCC CDM website.

Documents reviewed at this stage were as follows:

- Monitoring report (initial version 01.0, 21/05/2017 and final version 03, 02/03/2018) <sup>/01/</sup>
- Emission reductions calculation spreadsheet (initial version 01.0, 21/05/2017 and final version 3.0, 02/03/2018) <sup>/02/</sup>
- Registered PDD (version 10.4) <sup>/03/</sup>
- Validation Report <sup>/04/</sup>
- Revised monitoring plan<sup>/05/</sup> and Validation report of revised monitoring plan<sup>/06/</sup>
- Previous (1<sup>st</sup>) Monitoring Report <sup>/07/</sup>
- Previous (1<sup>st</sup>) Verification Report <sup>/08/</sup>
- Applied monitoring methodology, AMS-III.B version 12.0 <sup>/09/</sup>
- CDM operational Manual for LG Chem Naju plant <sup>/22/</sup>
- Other supplementary documents listed in 'Appendix 3' below

**D.2. On-site inspection**

Duration of on-site inspection: 26/07/2017				
No.	Activity performed on-site	Site location	Date	Team member
1.	Assess the implementation and operation status	LG Chem Naju Plant	26/07/2017	Sohn, Kyuil Han, Woncheol Moon, Hyunman
2	Review the information (from data generation, aggregation, to recording, calculation and reporting) for monitoring parameters			
3	Interviews with the operational personnel			
4	Cross check between information provided in the MR and ERP raw data, the value reported to the government by the Korea emissions trading scheme and so on.			
5	Check of monitoring equipment including calibration records			
6	Review the calculation in determining the GHG emission and emission reduction			
7	Identify the QA/QC procedure			

**D.3. Interviews**

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Hong	Min-Ho	Energy & Climate Change team	26/07/2017	- Reviewing of the Monitoring Report and spreadsheet - Evaluation of materiality - Baseline GHG emissions - Project GHG emissions - Leakage GHG emissions - GHG emission reductions	Sohn, Kyull Han, WonCheol Moon, HyunMan
	Shin	Kwang-Soo	Consultant (KIC)			
2.	Bae	Ju-yeong	SE Team (Energy Part)	26/07/2017	- Description and operation of the project activity - Implementation status of project activity - Verify the data and records - Monitoring the equipment in operation - Calibration performance	Sohn, Kyull Han, WonCheol Moon, HyunMan
	Ko	Young-Ju	SE Team (Energy Part)			
3	Yang	Man-Seung	Engineering Team	26/07/2017	- Internal Calibration for Instruments - Internal Instrument calibration procedure	Sohn, Kyull Han, WonCheol Moon, HyunMan
	Jung	Byeong-Yul	Engineering Team			

**D.4. Sampling approach**

>> Sampling approach is not applied during this verification process.

The required monitoring parameters during monitoring period are as below:

- $FF_{\text{project}, y}$ : Quantity of natural gas combusted in the project boiler during the year,  $y$  ( $\text{Nm}^3$ )
- $NCV_{\text{NG}, y}$ : Net calorific value of natural gas in year,  $y$  ( $\text{TJ}/\text{Nm}^3$ )
- $Q_{\text{total}, y}$ : Total quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during the year,  $y$  ( $\text{TJ}$ )

- $PG_y$  : Quantity of purge gas combusted in the project boiler during the year,  $y$  ( $Nm^3$ )
- $LF_y$  : Quantity of by-product liquid fuel combusted in the project boiler during the year,  $y$  (Litre)
- $NCV_{WG, y}$ : Net calorific value of purge gas ( $TJ / Nm^3$ )
- $NCV_{LF, y}$ : Net calorific value of by-product liquid fuel ( $TJ / litre$ )
- $\epsilon_{project, y}$ : Energy efficiency of the boiler during the year,  $y$  (%)

#### D.5. Clarification requests (CLs), corrective action requests (CARs) and forward action requests (FARs) raised

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
Compliance of the monitoring report with the monitoring report form	-	01	-
Compliance of the project implementation and operation with the registered PDD	01	-	-
Post-registration changes	-	-	-
Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines	-	-	-
Compliance of monitoring activities with the registered monitoring plan	01	01	-
Compliance with the calibration frequency requirements for measuring instruments	02	04	-
Assessment of data and calculation of emission reductions or net removals	-	-	-
Assessment of reported sustainable development co-benefits	-	-	-
Global stakeholder consultation	-	-	-
Others (please specify)	-	-	-
<b>Total</b>	<b>04</b>	<b>06</b>	<b>-</b>

### SECTION E. Verification findings

#### E.1. Compliance of the monitoring report with the monitoring report form

<b>Means of verification</b>	Verification team have cross checked all sections of the Monitoring Report <sup>/01/</sup> against the latest and valid version of Monitoring report form (CDM-MR-FORM) version 06.0 <sup>/10/</sup> . Each section in the report include proper information that required by relevant guidance. Verification team confirmed the CDM-MR-FORM version 06.0 <sup>/10/</sup> is correctly modified and applied. The latest instructions for filling out the MR have been followed.
<b>Findings</b>	CAR 06, refer to Appendix 4 Based on review of the revised MR, CAR 06 is appropriately revised and found satisfied.
<b>Conclusion</b>	Verification team confirms that monitoring report is complied with relevant the latest reporting template CDM-MR-FORM (Version 06.0) <sup>/10/</sup> and the instructions for filling out the monitoring report form attached.

#### E.2. Remaining forward action requests from validation and/or previous verifications

>> Verification team reviewed the previous verification report<sup>/08/</sup> and validation report<sup>/04/</sup>, but no FARs were issued.

### E.3. Compliance of the project implementation and operation with the registered project design document

<b>Means of verification</b>	<p>The project activity is a project activity to reduce the GHG emissions by switching from B-C oil to the natural gas. Verification team have carried out on-site assessment to verify implementation and operation against the description in the registered and approved PDD (version 10.4).</p> <p>1) Relevant date</p> <ul style="list-style-type: none"> <li>- The starting date of the project activity was 21/06/2006</li> <li>- Start date of the commercial operation was 20/11/2006.</li> <li>- 1<sup>st</sup> monitoring period was from 04/06/2009 to 23/02/2011</li> <li>- This 2<sup>nd</sup> monitoring period is from 24/02/2011 to 31/10/2016</li> </ul> <p>2) Description of the project activity</p> <p>The fuel-converted project boiler is as follows;</p> <ul style="list-style-type: none"> <li>- Boiler capacity : 70 T/H</li> <li>- Condition of steam produced: 35kg/cm<sup>2</sup>.g and 400°C</li> <li>- Fuel used: Natural gas, purge gas and by-product</li> </ul> <p>3) Operation and maintenance records<sup>/16/</sup></p> <ul style="list-style-type: none"> <li>- Boiler cleaning</li> <li>- Maintenance</li> </ul> <p>4) Verification</p> <p>Verification team have performed on-site visit to verify the actual implementation of the PA against the description in the registered PDD (V10.4)<sup>/03/</sup> as follows</p> <ul style="list-style-type: none"> <li>- The project boiler including natural gas burners are in place.</li> <li>- The operation status of the boiler including starting date of the PA and the start date of the commercial operation was checked through the Daily Operation record for 70 ton/h boiler<sup>/15/</sup>.</li> <li>- The project boiler are properly operating through maintenance of boiler (Annual plant shut down for maintenance<sup>/16/</sup> ) by PP.</li> </ul>
<b>Findings</b>	<p>CL03, refer to Appendix 4</p> <p>Based on the review of the revised MR, the revised emission reductions calculation spreadsheet and Supplementary document (PG gas fuelization project report<sup>/26/</sup>), CL03 was properly explained and found satisfied.</p>
<b>Conclusion</b>	<p>Verification team confirms that the project activity have been properly implemented as planned in the registered PDD<sup>/03/</sup>.</p> <ul style="list-style-type: none"> <li>- Implementation status is as described in the registered PDD<sup>/03/</sup></li> <li>- Timeline such as starting date of operation listed in the PDD is confirmed</li> <li>- There are no cause of any increase in the actual GHG emission reductions achieved by the registered PDD<sup>/03/</sup> in the current monitoring period that was reported in the Monitoring Report<sup>/01/</sup>.</li> </ul>

### E.4. Post-registration changes

#### E.4.1. Temporary deviations from the registered monitoring plan, applied methodologies or applied standardized baselines

>> No temporary deviations have been identified for this monitoring period

#### E.4.2. Corrections

>> No corrections have been identified for this monitoring period

**E.4.3. Change to the start date of the crediting period of the project activity**

>> No changes to the start date of the crediting period have been identified for this monitoring period.

**E.4.4. Inclusion of a monitoring plan**

>> No inclusion of a monitoring plan has been identified for this monitoring period

**E.4.5. Permanent changes from registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines or other applied standards or tools**

>> No permanent changes have been identified for this monitoring period

**E.4.6. Changes to the project design**

>> No changes have been identified for this monitoring period

**E.4.7. Changes specific to afforestation and reforestation project activities**

>> No changes have been identified for this monitoring period

**E.5. Compliance of the registered monitoring plan with the methodology including applicable tools and standardized baselines**

<b>Means of verification</b>	<p>Verification team have verified the monitoring plan against the applied methodology AMS-III.B (version 12.0)<sup>/09/</sup> to confirm the compliance, then conducted on-site assessment.</p> <p>Verification team have found that the monitoring system of the project activity is complete and in accordance with the applied monitoring methodology AMS-III.B version 12.0<sup>/09/</sup>. The monitoring procedures reflect the content of the monitoring plan. The applied monitoring methodology and sustaining records were sufficient to enable verification of emission reductions.</p>
<b>Findings</b>	No findings were raised.
<b>Conclusion</b>	KSA verification team confirms that the monitoring plan is in accordance with the approved monitoring methodology AMS-III.B version 12.0 <sup>/09/</sup> applied by project activity.

**E.6. Compliance of monitoring activities with the registered monitoring plan****E.6.1. Data and parameters fixed ex ante or at renewal of crediting period**

Means of verification	Verification team have verified the data and parameters fixed ex ante in the Monitoring Report against the registered PDD <sup>03/</sup> , validation report and applied methodology AMS-III.B version 12.0 <sup>09/</sup> .			
	1. Parameter Symbol for data and parameters fixed ex ante			
	Methodology	Registered PDD	MR	Checked
	Fuel use prior to the fuel switch	FF <sub>baseline</sub>	FF <sub>baseline</sub>	OK
		NCV <sub>baseline</sub>	NCV <sub>baseline</sub>	OK
		EF <sub>baseline,CO2</sub>	EF <sub>baseline,CO2</sub>	OK
PG <sub>baseline</sub>		PG <sub>baseline</sub>	OK	



	NCV <sub>PG, baseline</sub>	NCV <sub>PG, baseline</sub>	OK
	LF <sub>baseline</sub>	LF <sub>baseline</sub>	OK
	NCV <sub>LF, baseline</sub>	NCV <sub>LF, baseline</sub>	OK
Output for an appropriate period prior to the fuel switch	Q <sub>total, baseline</sub>	Q <sub>total, baseline</sub>	OK
Natural gas emission factor after fuel switch	EF <sub>NG,CO2</sub>	EF <sub>NG,CO2</sub>	OK

## 2. Parameter in the monitoring report(MR)

No.	Parameter in the PDD and MR	Description	Assessment
1	FF <sub>baseline</sub>	Quantity of bunker fuel oil C combusted in the baseline situation	As per the registered PDD <sup>/03/</sup> , 70,730.291 litre for FF <sub>baseline</sub> was appropriately applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
2	EF <sub>NG,CO2</sub>	CO2 emission factor of the natural gas combusted	As per the registered PDD <sup>/03/</sup> , 56.1 tCO <sub>2</sub> /TJ for EF <sub>NG,CO2</sub> was appropriately applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
3	NCV <sub>baseline</sub>	Net calorific value of bunker fuel oil C.	As per the registered PDD <sup>/03/</sup> , 39.1 X 10 <sup>-6</sup> TJ/liter for NCV <sub>baseline</sub> was appropriately applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
4	EF <sub>baseline, CO2</sub>	CO2 emission factor of bunker fuel oil C	As per the registered PDD <sup>/03/</sup> , 77.4 tCO <sub>2</sub> /TJ for EF <sub>baseline, CO2</sub> was applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
5	Q <sub>total baseline</sub>	Total quantity of steam generated by bunker fuel oil C, purge gas and by- product liquid fuel in the baseline situation	As per the registered PDD <sup>/03/</sup> , 3,701.09 TJ for Q <sub>total, baseline</sub> was applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
6	PG <sub>baseline</sub>	Quantity of purge gas combusted in the boiler in the baseline situation	As per the registered PDD <sup>/03/</sup> , 12,203,959 Nm <sup>3</sup> for PG <sub>baseline</sub> was applied to the Monitoring Report <sup>/01/</sup> and the emission reductions calculation sheet <sup>/02/</sup> .
7	LF <sub>baseline</sub>	Quantity of by-product liquid fuel combusted in the boiler in the baseline situation	As per the registered PDD <sup>/03/</sup> , 26,397,017 litre for LF <sub>baseline</sub> was applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
8	NCV <sub>PG, baseline</sub>	Net calorific value of purge gas	As per the registered PDD <sup>/03/</sup> , 52.15 X 10 <sup>-6</sup> TJ/Nm <sup>3</sup> for NCV <sub>PG, baseline</sub> was applied to the Monitoring Report <sup>/01/</sup> and the

			Emission Reductions Calculation sheet <sup>/02/</sup> .
	9	NCV <sub>LF, baseline</sub>	Net calorific value of by-product liquid fuel As per the registered PDD <sup>/03/</sup> , 30.576 X 10 <sup>-6</sup> TJ/litre for NCV <sub>LF, baseline</sub> was applied to the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .
	3. Verification 1) Verification team reviewed the following documents to verify the 'data and parameters fixed ex-ante of crediting period'. - The registered PDD <sup>/03/</sup> - Validation Report 2) Verification team checked the 'data and parameters fixed ex-ante of crediting period' in the registered PDD were accurately reflected in the Monitoring Report <sup>/01/</sup> and the Emission Reductions Calculation sheet <sup>/02/</sup> .		
<b>Findings</b>	No findings were raised.		
<b>Conclusion</b>	Verification team confirm that the ex-ante parameter is correctly applied and the value of the ex-ante parameter in the MR is consistent with the same in the registered PDD <sup>/03/</sup> , the applied methodology <sup>/09/</sup> , the revised monitoring plan <sup>/05/</sup> , the validation Report <sup>/04/</sup> , and validation report of the revised monitoring plan <sup>/06/</sup> .		

### E.6.2. Data and parameters monitored

<b>Means of verification</b>	<p>The monitoring parameters in the GHG emission reduction calculation have been monitored in accordance with the monitoring plan described in the registered PDD. The monitoring mechanism, including the data collection and report, is effective and reliable. During the site visit, personnel involved at the appropriate level of operation of project activity have been interviewed.</p> <p>Verification team have assessed all relevant monitoring parameter as listed in chapter B.7.1 of the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> as follows;</p> <ol style="list-style-type: none"> <li>1) Appropriateness of the applied measurement/determination method</li> <li>2) Correctness of the values applied for ER calculation</li> <li>3) Accuracy and the applied QA/QC measures</li> </ol> <p>Verification team have assessed whether relevant monitoring parameter and defined in the registered PDD and the applied methodology are correctly described in the monitoring report as bellows;</p> <ol style="list-style-type: none"> <li>1. Parameter Symbol for data and parameters monitored.</li> </ol> <table border="1"> <thead> <tr> <th>Methodology</th><th>PDD</th><th>MR</th><th>Checked</th></tr> </thead> <tbody> <tr> <td rowspan="6">Fuel use after the fuel switch</td><td>FF<sub>project, y</sub></td><td>FF<sub>project, y</sub></td><td>OK</td></tr> <tr> <td>NCV<sub>NG, y</sub></td><td>NCV<sub>NG, y</sub></td><td>OK</td></tr> <tr> <td>PG<sub>y</sub></td><td>PG<sub>y</sub></td><td>OK</td></tr> <tr> <td>NCV<sub>WG, y</sub></td><td>NCV<sub>WG, y</sub></td><td>OK</td></tr> <tr> <td>LF<sub>y</sub></td><td>LF<sub>y</sub></td><td>OK</td></tr> <tr> <td>NCV<sub>LF, y</sub></td><td>NCV<sub>LF, y</sub></td><td>OK</td></tr> <tr> <td rowspan="2">Output after the fuel switch</td><td>Q<sub>total, y</sub></td><td>Q<sub>total, y</sub></td><td>OK</td></tr> <tr> <td>ε<sub>project, y</sub></td><td>ε<sub>project, y</sub></td><td>OK</td></tr> </tbody> </table> <ol style="list-style-type: none"> <li>2. Parameter in the monitoring report(MR)</li> </ol>			Methodology	PDD	MR	Checked	Fuel use after the fuel switch	FF <sub>project, y</sub>	FF <sub>project, y</sub>	OK	NCV <sub>NG, y</sub>	NCV <sub>NG, y</sub>	OK	PG <sub>y</sub>	PG <sub>y</sub>	OK	NCV <sub>WG, y</sub>	NCV <sub>WG, y</sub>	OK	LF <sub>y</sub>	LF <sub>y</sub>	OK	NCV <sub>LF, y</sub>	NCV <sub>LF, y</sub>	OK	Output after the fuel switch	Q <sub>total, y</sub>	Q <sub>total, y</sub>	OK	ε <sub>project, y</sub>	ε <sub>project, y</sub>	OK
Methodology	PDD	MR	Checked																														
Fuel use after the fuel switch	FF <sub>project, y</sub>	FF <sub>project, y</sub>	OK																														
	NCV <sub>NG, y</sub>	NCV <sub>NG, y</sub>	OK																														
	PG <sub>y</sub>	PG <sub>y</sub>	OK																														
	NCV <sub>WG, y</sub>	NCV <sub>WG, y</sub>	OK																														
	LF <sub>y</sub>	LF <sub>y</sub>	OK																														
	NCV <sub>LF, y</sub>	NCV <sub>LF, y</sub>	OK																														
Output after the fuel switch	Q <sub>total, y</sub>	Q <sub>total, y</sub>	OK																														
	ε <sub>project, y</sub>	ε <sub>project, y</sub>	OK																														

	No.	Parameter in PDD and MR	Description	Assessment
	1	FF <sub>project, y</sub>	Quantity of natural gas combusted in the project boiler during the year, y	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: Quantity of NG consumption are continuously measured by the meter (Tag No. FQ_7105).</li> <li>Monitoring equipment: The measuring instrument is the meter (Tag No. FQ_7105) installed at the boiler inter and the meter is calibrated every 3 years.</li> <li>Data source: Data are measured directly on-site and the measured values are transmitted to the control room and stored in PIS and also recorded in the daily log manually.</li> <li>The reported data are cross-checked with the quantity of NG purchased from NG supplier (Haeyang City Gas Co. Ltd.) and the mass balance. And also it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be compared. The NG consumed by the project boiler can be cross-checked with the purchase record. The flow meter for NG is calibrated by the 3<sup>rd</sup> party calibration body under ISO 17025 scheme.</li> </ul>
	2	PG <sub>y</sub>	Quantity of purge gas combusted in the project boiler during year, y	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: Quantity of purge gas consumption are continuously measured by the meter (Tag No. FQ_7106).</li> <li>Monitoring equipment: The measuring instrument is the meter (Tag No. FQ_7106) installed at the boiler inter and the meter is calibrated every year.</li> <li>Data source: Data are measured directly on-site and the measured values are transmitted to the control room and stored in PIS and also recorded in the daily log manually.</li> <li>The reported data are cross-checked with the daily log sheet. And also it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be</li> </ul>

				<p>compared.</p> <p>The flow meter for purge gas is calibrated by the qualified personnel of LG Chem as per the calibration procedure specified in the LG CDM operation manual.</p>
	3	LF <sub>y</sub>	Quantity of by-product liquid fuel combusted in the project boiler during year, y	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: Quantity of the by-product liquid fuel consumption are continuously measured by the meter (Tag No. FQ-7104).</li> <li>Monitoring equipment: The measuring instrument is the meter (Tag No. FQ-7104) installed at the boiler inter and the meter is calibrated every 3 years.</li> <li>Data source: Data are measured directly on-site and the measured values are transmitted to the control room and stored in PIS and also recorded in the daily log manually.</li> <li>The reported values are cross-checked with the daily log sheet. And also it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be compared. The flow meter for by-product liquid fuel is calibrated by the 3<sup>rd</sup> party calibration body under ISO 17025 scheme.</li> </ul>
	4	NCV <sub>NG, y</sub>	Net calorific value of natural gas	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: N/A NCV<sub>NG, y</sub> is not measured by the measurement instrument, but determined by "Energy Act" in Korea.</li> <li>Monitoring equipment: N/A</li> <li>Data source: "Calorific value table" in "Energy Act" of Korea.</li> <li>Cross-check: N/A</li> <li>Data QA/QC NCV<sub>NG, y</sub> is determined by Energy Act. The weighted average is applied to the MR and the emission reduction spread sheet,</li> </ul>
	5	NCV <sub>WG, y</sub>	Net calorific value of purge gas	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: NCV<sub>WG, y</sub> is measured by Gas Chromatograph every quarter. The measured value is weighted average considering the purge gas consumed in the project boiler. .</li> <li>Monitoring equipment: Gas Chromatograph.</li> <li>Data source: Measured and weighted average.</li> </ul>

				<ul style="list-style-type: none"> <li>• Cross-check: it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>• Data QA/QC NCV<sub>WG, y</sub> is measured by PP as per ASTM D 3588 (Standard practice for calculating heat value, Compressibility Factor, and Relative Density (specific gravity) of gaseous fuel). The measurement was carried out by the qualified person using the reference material (standard gas). The weighted average is applied to the MR and the emission reduction spread sheet,</li> </ul>
	6	NCV <sub>LF, y</sub>	Net calorific value of by-product liquid fuel	<ul style="list-style-type: none"> <li>• Measuring/reading/reporting frequency: NCV<sub>LF, y</sub> is measured by 3<sup>rd</sup> party, KTR that ISO 17025 certified body quarterly.</li> <li>• Monitoring equipment: N/A (measured by 3<sup>rd</sup> party, KTR)</li> <li>• Data source: Test Report by KTR.</li> <li>• Cross-check: it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>• Data QA/QC tested by the 3<sup>rd</sup> party, KTR</li> </ul>
	7	Q <sub>total, y</sub>	Total quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during year, y	<ul style="list-style-type: none"> <li>• Measuring/reading/reporting frequency: Quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during the year, y are continuously measured by the meter (Tag No. FQ_7102).</li> <li>• Monitoring equipment: The measuring instrument is the meter (Tag No. FQ_7102) installed at the boiler inter and the meter is calibrated every year.</li> <li>• Data source: Data are measured directly on-site and the measured values are transmitted to the control room and stored in PIS and also recorded in the daily log manually.</li> <li>• The reported values are cross-checked with the daily log sheet. And also it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>• Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be</li> </ul>

				<p>compared each other.</p> <p>The flow meter for steam generated is calibrated by the qualified personnel of LG Chem as per the calibration procedure specified in the LG CDM operation manual.</p>
	8	$\epsilon_{\text{project, y}}$	<p>Energy efficiency of the boiler during the year, y</p>	<ul style="list-style-type: none"> <li>Measuring/reading/reporting frequency: Energy efficiency (<math>\epsilon_{\text{project, y}}</math>) is calculated by the direct method (dividing the net heat generation by the energy content of the fuel combusted in the project boiler)r. .</li> <li>Monitoring equipment: N/A (calculated by the direct method)</li> <li>Data source: the calculated value using the measured data.</li> <li>Cross-check: it can be cross-checked with the value<sup>/27/</sup> reported to the government after verified by the 3<sup>rd</sup> party verification body under Korea emission trading scheme.</li> <li>Data QA/QC Relevant parameters (steam generation, fuel consumption) are calibrated periodically according to "LG Chem plant CDM Manual". The qualified personnel calculated the energy efficiency of boiler.</li> </ul>
<b>Findings</b>	No findings were raised.			
<b>Conclusion</b>	Verification team confirm that all monitoring parameter have been measured/calculated without any material misstatements and carried out in accordance with the revised monitoring plan <sup>/05/</sup> and the registered PDD <sup>/03/</sup> .			

<b>Means of verification</b>	<p>1. FF<sub>project, y</sub>:</p> <p>1) Description Quantity of natural gas combusted in the project boiler during the year, y</p> <p>2) Source of data : the measured value on-site</p> <p>3) Value applied: 87,504,351 Nm<sup>3</sup>          - Before 01/01/2013: 30,902,352 Nm<sup>3</sup>          - From 01/01/2013: 56,601,999 Nm<sup>3</sup></p> <p>4) Monitoring equipment The meter (Tag No. FQ_7105) is used to measure the quantity of NG consumption in the project boiler</p> <p>5) Calibration frequency: The gas flow meter (Tag No. FQ_7105) is calibrated every 3 years and other meters (thermometer and pressure gauge) related to the</p>
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	<p>quantity of NG combusted in the project boiler are also calibrated by every 3 years.</p> <p>6) Cross-checked with other available source:</p> <ul style="list-style-type: none"> <li>• The reported data are cross-checked with the quantity of NG purchased from NG supplier (Haeyang City Gas Co. Ltd.) and the mass balance.</li> <li>• LG Chem Naju plant is required to report the emissions to Korean government by emission facility under KETS(Korea Emission Trading System). Therefore the reported data are cross-checked with Korean government reporting information.</li> </ul> <p>7) Verification</p> <p>Verification team has assessed the <math>FF_{project, y}</math> (Quantity of natural gas combusted in the project boiler during the year, y) through follows;</p> <ul style="list-style-type: none"> <li>- The reported data was measured by the calibrated gas flow meter.</li> <li>- The reported data was checked through the PIS information<sup>/13/</sup> and the daily log sheet<sup>/15/</sup> and compared to the purchase quantity<sup>/28/</sup> provided by NG supplier (Haeyang city gas Co. Ltd.) using the mass balance.</li> <li>- Finally, the reported data have been cross-checked with the value<sup>/27/</sup> reported by the project participant to the government.</li> </ul>
<b>Findings</b>	No findings were raised.
<b>Conclusion</b>	<p>Verification team confirms that the quantity of NG combusted in the project boiler during year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>2. <math>NCV_{NG, y}</math>:</p> <p>1) Description</p> <p>Net calorific value of natural gas in year y</p> <p>2) Source of data: "Standard Manual for Calorific Value" in "Energy Act"<sup>/23/</sup> of Korean government.</p> <p>3) Value applied:</p> <ul style="list-style-type: none"> <li>- Before 01/01/2013: <math>39.65 \times 10^{-6} \text{ TJ/Nm}^3</math></li> <li>- From 01/01/2013: <math>39.4 \times 10^{-6} \text{ TJ/Nm}^3</math></li> </ul> <p>The applied values before /01/01/2013 was the weighted average. (Refer to the Excel sheet for NCV weighted average calculation)</p> <ul style="list-style-type: none"> <li>- <math>NCV_{NG, y}</math> from 24/02/2011 to 31/12/2011: <math>40.0 \times 10^{-6} \text{ TJ/Nm}^3</math></li> <li>- <math>NCV_{NG, y}</math> from 01/01/2012 to 31/12/2012: <math>39.4 \times 10^{-6} \text{ TJ/Nm}^3</math></li> </ul> <p>4) Monitoring equipment: Not applicable</p> <p>The value is from the "Standard Manual for Calorific Value" in "Energy Act"<sup>/23/</sup> of Korean government.</p> <p>5) Calibration frequency: Not applicable</p>
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	<p>6) Cross-checked with other available source: Not applicable. The value is from the “Standard Manual for Calorific Value” in “Energy Act”<sup>/23/</sup> of Korean government.</p> <p>7) Verification Verification team has assessed the <math>NCV_{NG, y}</math> (Net Calorific value of natural gas in year y) through follows;  - The reported data is from the “Calorific Value Table in “Energy Act”<sup>/23/</sup> of Korean Government.  - The reported data is the same as the weighted average of the changed values during this monitoring period”.</p>
<b>Findings</b>	<p>CAR 02, refer to Appendix 4. Based on the review of the revised MR and the emission reductions spreadsheet, CAR 02 is properly corrected and found satisfied.</p>
<b>Conclusion</b>	<p>Verification team confirms that “Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan”<sup>/05/</sup> and the registered PDD”<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>3. <math>Q_{total, y}</math>:</p> <p>1) Description Total quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during the year y</p> <p>2) Source of data: The value calculated by considering steam condition after measuring the quantity of steam.</p> <p>3) Value applied: 6,251.92 TJ  - Before 01/01/2013: 2,123.35 TJ  - From 01/01/2013: 4,128.57 TJ</p> <p><math>Q_{total, y}</math> = (Quantity of generated steam by project boiler)  X (Steam enthalpy – feed water enthalpy)  = 2,310,954 ton X (3,174.26 – 468.92) MJ/ton X <math>10^{-6}</math> TJ/MJ  = 6,251.92 TJ</p> <p>The above values included the adjusted value due to the delayed calibration for steam flow meter (FQ-7102). Refer to CAR 04.in the Appendix.</p> <p>Value applied were calculated as below:</p> <ul style="list-style-type: none"> <li>- Under Quantity of steam generated by project boiler are continuously measured by steam flow meter (FQ-7102) and temperature and pressure of steam are also measured by thermometer (TE-7112) and pressure gauge (PT-7101) respectively.</li> <li>- Design condition of steam generated by the project boiler are 27kg/cm<sup>2</sup> and 393°C and feed water is 110.5°C during this monitoring period. But in actual operation steam and feed water condition are fluctuating. Thus, PP have</li> </ul>
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	<p>applied the most conservative conditions of 26.6kg/cm<sup>2</sup> and 374°C for the generated steam measured in 2013.during monitoring period. And 112 kcal/kg (112°C) for feed water measured in 2012 during monitoring period. According to the steam table, the enthalpy of steam and feed water for the above condition is 3,174.26 MJ/ton and 468.92 MJ/ton respectively.</p> <p>4) Monitoring equipment The meter (Tag No. FQ_7102) is used to measure the quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during the year y.</p> <p>5) Calibration frequency: The gas flow meter (Tag No. FQ_7102) is calibrated every 3 years and other meters (thermometer and pressure gauge) related to the quantity of steam generated by project boiler are also calibrated by every year.</p> <p>6) Cross-checked with other available source: LG Chem Naju Plant is required to report the emissions to Korean government by emission facility under KETS(Korea Emission Trading System). Therefore the reported data are cross-checked with Korean government reporting information</p> <p>7) Verification Verification team has assessed the <math>Q_{total, y}</math> (Total quantity of steam generated by the project boiler) through follows;  - The reported data was measured by the calibrated flow meter.  - The reported data was checked through the PIS information and the daily log sheet.  - Finally, the reported data have been cross-checked with the value reported by the project participant to the government.</p>
<b>Findings</b>	<p>CAR 04, refer to Appendix 4.</p> <p>Based on the review of the revised MR and the emission reduction calculation spread sheet, CAR 04 is appropriately corrected and found satisfied.</p>
<b>Conclusion</b>	<p>Verification team confirms that the quantity of NG combusted in the project boiler during year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>4. PG<sub>y</sub>:</p> <p>1) Description Quantity of purge gas combusted in the project boiler during the year, y</p> <p>2) Source of data : the measured value on-site</p> <p>3) Value applied: 47,391,798Nm<sup>3</sup>  - Before 01/01/2013: 12,825,597 Nm<sup>3</sup></p>
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	<p>- From 01/01/2013: 34,566,201 Nm<sup>3</sup></p> <p>The above values included the adjusted value due to the delayed calibration for the purge gas flow meter (FQ-7106). Refer to CAR 03.in the Appendix.</p> <p>4) Monitoring equipment The meter (Tag No. FQ-7106) is used to measure the quantity of purge gas combusted in the project boiler during the year y.</p> <p>5) Calibration frequency: The gas flow meter (Tag No. FQ-7106) is calibrated every year and thermometer (TE-7106) related to the quantity of purge gas combusted in the project boiler are also calibrated by every 3 years.</p> <p>6) Cross-checked with other available source:</p> <ul style="list-style-type: none"> <li>• The reported data are cross-checked with the daily log.</li> <li>• LG Chem Naju Plant is required to report the emissions to Korean government by emission facility under KETS(Korea Emission Trading System). Therefore the reported data are cross-checked with Korean government reporting information.</li> </ul> <p>7) Verification Verification team has assessed the PG<sub>y</sub> (Quantity of purge gas combusted in the project boiler during the year, y) through follows;</p> <ul style="list-style-type: none"> <li>- The reported data was measured by the calibrated gas flow meter.</li> <li>- The reported data was checked through the PIS information and the daily log sheet.</li> <li>- Finally, the reported data have been cross-checked with the value reported by the project participant to the government.</li> </ul>
<b>Findings</b>	<p>CAR 04, refer to Appendix 4.</p> <p>Based on the review of the revised MR and the emission reduction spread sheet, CAR 04 is appropriately corrected and found satisfied.</p>
<b>Conclusion</b>	<p>Verification team confirms that the quantity of NG combusted in the project boiler during year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>5. NCV<sub>WG, y</sub>:</p> <p>1) Description Net calorific value of purge gas in year y</p> <p>2) Source of data: Calculated value using data measured by gas calorimeter quarterly as per ASTM D 3588 (Standard practice for calculating heat value, compressibility factor, and relative density of gases fuels.</p> <p>3) Value applied: 44.10 X 10<sup>-6</sup> TJ/Nm<sup>3</sup></p> <ul style="list-style-type: none"> <li>- Before 01/01/2013: 57.68 X 10<sup>-6</sup> TJ/Nm<sup>3</sup></li> <li>- From 01/01/2013: 39.06 X 10<sup>-6</sup> TJ/Nm<sup>3</sup></li> </ul> <p>The detailed calculation value refer to the NCV sheet in the Emission Reduction Spreadsheet.</p>
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	<p>PP have measured the <math>NCV_{WG,y}</math> quarterly and weighted averages of measured value into quarterly purge gas consumed in the project boiler. And the results are appropriately applied to the emission calculation ER calculation sheet.</p> <p>4) Monitoring equipment: Gas chromatograph</p> <p>5) Calibration frequency: Not applicable. Gas chromatograph is controlled by a standard calibration curve using the reference material (standard gas within the validity period) as per "LG CDM Operation Manual" which the followings are specified ;</p> <ul style="list-style-type: none"> <li>- the test and analysis method for NCV</li> <li>- qualification of test/inspection personnel</li> <li>- O&amp;M for test equipment</li> <li>- Certificate of used standard material (gas)</li> </ul> <p>6) Cross-checked with other available source: the reported values are cross-checked with the value verified by the 3<sup>rd</sup> party verification body and approved by the Korean government as per K-ETS.</p> <p>7) Verification</p> <ul style="list-style-type: none"> <li>- Verification team checked the K-ETS regulation (Guideline for greenhouse gas and energy target management scheme) and Guideline for development of emission factor.</li> <li>- Verification team checked the test method, test procedure, qualification of tester, test instruments which are specified in the "CDM operation manual"<sup>/22/</sup> and also checked the related documents such as contract of GC maintenance, reference material (standard gas).</li> <li>- The test was carried out every quarter during this monitoring period and PP calculated the values by weighted average.</li> <li>- Finally, verification team cross-checked the values with the value reported by the project participant to the government.</li> </ul>
<b>Findings</b>	<p>Not applicable. No findings were raised.</p>
<b>Conclusion</b>	<p>Verification team confirms that "Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet..</p>

<b>Means of verification</b>	<p>6. <math>LF_y</math>:</p> <p>1) Description Quantity of by-product liquid fuel combusted in the project boiler during the year, y</p> <p>2) Source of data: measured on-site and transmitted into PIS and archived.</p> <p>3) Value applied: 51,526,436 litres - Before 01/01/2013: 17,694,695 litres</p>
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	<p>- From 01/01/2013: 33,831,742 litres</p> <p>4) Monitoring equipment The meter (Tag No. FQ_7104) is used to measure the quantity of by-product liquid combusted in the project boiler during the year y.</p> <p>5) Calibration frequency: The gas flow meter (Tag No. FQ_7104) is calibrated every year.</p> <p>6) Cross-checked with other available source:</p> <ul style="list-style-type: none"> <li>• The reported data are cross-checked with the daily log.</li> <li>• LG Chem Naju Plant is required to report the emissions to Korean government by emission facility under KETS(Korea Emission Trading System). Therefore the reported data are cross-checked with Korean government reporting information.</li> </ul> <p>7) Verification Verification team has assessed the <math>LF_y</math> (Quantity of by-product liquid fuel combusted in the project boiler during the year, y) through follows;</p> <ul style="list-style-type: none"> <li>- The reported data was measured by the calibrated flow meter.</li> <li>- The reported data was checked through the PIS information and the daily log sheet.</li> <li>- Finally, the reported data have been cross-checked with the value reported by the project participant to the government.</li> </ul>
<b>Findings</b>	<p>CAR 05, refer to Appendix 4.</p> <p>Based on the review of the revised MR and the emission reduction spread sheet, CAR 05 is appropriately corrected and found satisfied.</p>
<b>Conclusion</b>	<p>Verification team confirms that the quantity of by-product liquid fuel combusted in the project boiler during year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>7. <math>NCV_{LF, y}</math>:</p> <p>1) Description Net calorific value of by-product liquid fuel</p> <p>2) Source of data: weighted average value using data measured by the 3<sup>rd</sup> party body, KTR (Korea Testing and Research Institute accredited by KOLAS).</p> <p>3) Value applied: <math>28.28 \times 10^{-6}</math> TJ/litre</p> <ul style="list-style-type: none"> <li>- Before 01/01/2013: <math>29.26 \times 10^{-6}</math> TJ/litre</li> <li>- From 01/01/2013: <math>27.77 \times 10^{-6}</math> TJ/litre</li> </ul> <p>The detailed calculation value refer to the NCV sheet in the Emission Reduction Spreadsheet.</p> <p><math>NCV_{LF, y}</math> were measured by 3<sup>rd</sup> party body quarterly and were weighted averages. And the results are appropriately applied to the emission calculation</p>
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	<p>ER calculation sheet.</p> <p>4) Monitoring equipment: Not applicable NCV<sub>LF, y</sub> were measured by 3<sup>rd</sup> party body, KTR accredited by KOLAS as per ISO 17025)</p> <p>5) Calibration frequency: Not applicable NCV<sub>LF, y</sub> were measured by 3<sup>rd</sup> party body, KTR accredited by KOLAS as per ISO 17025)</p> <p>6) Cross-checked with other available source: the reported values are cross-checked with the value verified by the 3<sup>rd</sup> party verification body and approved by the Korean government as per K-ETS.</p> <p>7) Verification</p> <ul style="list-style-type: none"> <li>- Verification team checked the test report tested by KTR.</li> <li>- The test was carried out every quarter during this monitoring period and PP calculated the values by weighted average.</li> <li>- Finally, verification team cross-checked the values with the value reported by the project participant to the government.</li> </ul>
<b>Findings</b>	<p>Not applicable.</p> <p>No findings were raised.</p>
<b>Conclusion</b>	<p>Verification team confirms that "Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the value are appropriately applied to the MR and the emission reductions spread sheet.</p>

<b>Means of verification</b>	<p>8. <math>\epsilon_{\text{project, y}}</math>:</p> <p>1) Description Energy efficiency of the boiler during the year, y</p> <p>2) Source of data : the calculated value using measured value by direct method (dividing the net heat generation by the energy content of the fuels combusted in the project boiler)</p> <p>3) Value applied: 89.28%          - Before 01/01/2013: 85.52%          - From 01/01/2013: 91.34%          Boiler efficiency is the weighted average for each period.</p> <p>4) Monitoring equipment: Not available.</p> <p>5) Calibration frequency: Not available.</p> <p>6) Cross-checked with other available source: N/A          This parameter does not directly affect the emission reductions but only to check the efficiency variation of the project boiler during the monitoring period..</p> <p>7) Verification          Verification team assessed the <math>\epsilon_{\text{project, y}}</math> (Energy efficiency of the project boiler</p>
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	<p>during the year, y) as follows;</p> <ul style="list-style-type: none"> <li>- Verification team checked the input data (fuel consumption – natural gas, purge gas and by-product liquid fuel) and the output data (steam), based on the caloric value in the concept of heat balance.</li> <li>- Verification team checked that the main variables of energy efficiency are attributed to the economizer and air preheater and are associated with their cleaning cycle.</li> <li>- Finally, verification team checked the calculation process of energy efficiency in the project boiler during the year.</li> </ul>
<b>Findings</b>	<p>CL 02, refer to Appendix 4.</p> <p>Based on the review of the revised MR, CL 02 is appropriate corrected and found satisfied</p>
<b>Conclusion</b>	<p>Verification team confirms that the energy efficiency of boiler during the year, y (<math>\epsilon_{\text{project, y}}</math>) are appropriately managed as described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup>.</p>

### E.6.3. Implementation of sampling plan

<b>Means of verification</b>	N/A
<b>Findings</b>	N/A
<b>Conclusion</b>	Sampling plan is not developed in the revised monitoring plan and the registered PDD <sup>/03/</sup> .

### E.7. Compliance with the calibration frequency requirements for measuring instruments

Means of verification

Verification team have performed the documents review of the calibration records of the monitoring meters to confirm the compliance of the calibration as follows;  
- Previous (1<sup>st</sup>) monitoring report<sup>/07/</sup> and the previous (1<sup>st</sup>) verification report<sup>/08/</sup>  
- Registered PDD<sup>/03/</sup>  
- Validation Report<sup>/04/</sup>  
- Revised monitoring plan<sup>/05/</sup>  
- Validation report of revised monitoring plan<sup>/06/</sup>  
- Approved methodology AMS-III.B.<sup>/09/</sup>  
- CDM Operation Manual for LG Chem Naju Plant.<sup>/22</sup>

The parameters monitored to calculate the emission reduction during the monitoring period are as follows;

1. FF<sub>project, y</sub>:

1) Description: Quantity of natural gas combusted in the project boiler during the year, y

2) Monitoring equipment and calibration information

① Gas flow meter

Subjects	Contents	Remarks
Type	Vortex	
Accuracy	±1.0% Full scale	
Model	VXW-1150-N11G-1116	
Tag No./SN	FQ-7105 / 15-S0728HN	
Calibration entity	3 <sup>rd</sup> Party Calibration body	
Calibration frequency	Every 3 years	

Previous calibration (Cert. No.)	05/11/2010 (OKA10-11-133) (Uncertainty: 0.44%)	OK
Latest calibration (Cert. No.)	04/11/2013 (OKA13-11-213) (Uncertainty: 0.42%)	OK
Applied period of max. permissible errors where applicable	N/A	

- The gas flow meter (FQ-7105) was calibrated by the 3<sup>rd</sup> party calibration laboratory (FLOTROK) under KOLAS (Korea Laboratory Accreditation Scheme) within validity

② Thermometer (Auxiliary meter)

Subjects	Contents	Remarks
Type	thermometer	
Accuracy	±0.1%	
Tag No./SN	FE_7105 / 06019524	
Calibration entity	3 <sup>rd</sup> Party Calibration body	
Calibration frequency	Every 3 years	
Previous calibration	Unknown	OK
Latest calibration (Cert. No.)	14/11/2013 (E313845)	OK
Applied period of max. permissible errors where applicable	N/A	

- 1<sup>st</sup> Calibration date: 14/11/2013: verified during the 1<sup>st</sup> monitoring period (refer to the 1<sup>st</sup> Verification Report)
- 1<sup>st</sup> The calibration validity is still valid.
- The thermometer (TE-7105) was calibrated by the 3<sup>rd</sup> party calibration laboratory (Konics) under KOLAS (Korea Laboratory Accreditation Scheme).
- The applied period of max. permissible error when applicable: N/A  
(Monitoring period is from 24/02/2011 to 31/10/2016 within validity)

③ Pressure gauge (Auxiliary meter)

Subjects	Contents	Remarks
Type	Pressure gauge	
Accuracy	±3.0%	
Tag No./SN	PT-7105 /0634 060818050002	
Calibration entity	Internal Calibration	
Calibration frequency	Every 3 years	
Previous calibration	11/09/2010/0.2%	OK
	03/11/2013/1.0%	OK
Latest calibration	16/04/2016/0.7%	OK
Applied period of max. permissible errors where applicable	N/A	

- The previous calibration was calibrated by internal calibration on 11/09/2010 and 03/11/2013 (refer to CL04)
- The latest calibration date: 16/04/2016:
- The pressure gauge (PT-7105) was calibrated by the internal using the calibration standard instrument (Digital multi-meter, S/N: 6210191)<sup>1/21/</sup>

- The applied period of max. permissible error when applicable: N/A  
(Monitoring period is from 24/02/2011 to 31/10/2016 within validity)

## 3) Verification

- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan<sup>/05/</sup> and related validation report<sup>/06/</sup>, 1<sup>st</sup> monitoring report<sup>/07/</sup> and 1<sup>st</sup> verification report<sup>/08/</sup>, and the registered PDD<sup>/03/</sup> and Validation report<sup>/04/</sup>)
- Verification team have checked whether the measuring meter was calibrated within the calibration period or not.
- Verification team reviewed the calibration results including error in the calibration certificate provided by PP.

2.  $NCV_{NG, y}$ :

1) Description: Net calorific value of natural gas in year, y

2) Monitoring equipment and calibration information: N/A

$NCV_{NG, y}$  is determined by "Standard Manual for Calorific Value" in "Energy Act" of Korea as per the monitoring plan. Thus, Net calorific value of natural gas in year, y is not required to calibrate.

3.  $Q_{total, y}$ :

1) Description: Total quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during year y.

2) Monitoring equipment and calibration information :

## ① Flow meter

Subjects	Contents	Remarks
Type	Differential pressure flow meter	
Manufacturer	Honeywell	
Model	STD924-E1H-0000-S2.MB. SM.GC.F1.3D-B77P	
Accuracy	±2.0% Full scale	
Tag No./SN	FQ-7102 / 41000404001	
Calibration entity	Internal Calibration	
Calibration frequency	Every 1 year	
Previous calibration	11/09/2010	OK
	26/09/2011 (0.2%)	NG
	10/09/2012 (4.7%)	OK
	03/11/2013 (0.1%)	NG
	09/10/2014 (0.2%)	OK
Latest calibration	15/11/2015 (0.7%)	NG
Applied period of max. permissible errors where applicable	From 12/09/2011 to 25/09/2011 From 11/09/2013 to 02/11/2013 From 30/10/2014 to 14/11/2015	Refer to CAR 04

- The previous calibration were calibrated as above table. (refer to CAR04)
- The latest calibration date: 15/11/2015.:
- The steam flow meter (FQ-7102) was calibrated by the internal using the calibration standard instrument (Digital multi-meter, S/N: 6210191<sup>/21/</sup>).
- The applied period of max permissible error when applicable: applied.  
From 12/09/2011 to 25/09/2011



From 11/09/2013 to 02/11/2013  
From 30/10/2014 to 14/11/2015

② Thermometer (Auxiliary meter)

Subjects	Contents	Remarks
Type	Vortex (Orifice)	
Accuracy	±0.1%	
Tag No./SN	TE_7102 / 06019524	
Calibration entity	3 <sup>rd</sup> party calibration	
Calibration frequency	Every 3 year	
Previous calibration	Unknown (verified during the 1 <sup>st</sup> verification, refer to the 1 <sup>st</sup> VR)	OK
Latest calibration (Cert. No.)	14/11/2013 / E313845	OK
Applied period of max. permissible errors where applicable	N/A	

- The thermometer (TE-7102) was calibrated by the 3<sup>rd</sup> party calibration laboratory (Konics) under KOLAS (Korea Laboratory Accreditation Scheme) within validity
- The applied period of max. permissible error when applicable: N/A (Monitoring period is from 24/02/2011 to 31/10/2016 within validity)

3) Verification

- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan and related validation report, 1<sup>st</sup> monitoring report and 1<sup>st</sup> verification report, and the registered PDD and Validation report)
- Verification team checked whether the measuring meter was calibrated within the calibration period or not.
- Verification team reviewed the calibration results including error in the calibration certificate provided by PP.
- Verification team assessed the internal calibration procedure such as test method, test standard, qualification of tester, validity of applied standard meter<sup>/20/</sup>.

4. PG<sub>y</sub>

1) Description: Quantity of purge gas combusted in the project boiler during the year, y

2) Monitoring equipment and calibration information

① Gas flow meter

Subjects	Contents	Remarks
Type	Differential pressure flow meter	
Manufacturer	FUJI	
Model Type	EJA110A Style S1	
Accuracy	±2.0% Full scale	
Tag No./SN	FQ-7106 / N9CO596T	
Calibration entity	Internal Calibration	
Calibration frequency	Every 1 year	
Previous calibration	11/09/2010	OK

	26/09/2011	NG
	10/09/2012	NG
	04/11/2013	NG
	29/10/2014	OK
	15/11/2015	OK
Latest calibration	16/04/2016	NG
Applied period of max. permissible errors where applicable	From 12/04/2011 to 25/09/2011 From 11/09/2013 to 03/11/2013 From 30/10/2015 to 14/11/2015	Refer to CAR 03

- The previous calibration were calibrated as above table. (refer to CAR03)
- The latest calibration date: 16/04/2016.:
- The flow (FQ-7106) was calibrated by the internal using the calibration standard instrument (Digital multi-meter, S/N: 6210191)<sup>/21/</sup>.
- The applied period of max permissible error when applicable: applied.  
From 12/04/2011 to 25/09/2011  
From 11/09/2013 to 03/11/2013  
From 30/10/2015 to 14/11/2015

② Thermometer (Auxiliary meter)

Subjects	Contents	Remarks
Type	Thermometer	
Accuracy	±0.1%	
Tag No./SN	TE_7106 / TE-002	
Calibration entity	3 <sup>rd</sup> party calibration	
Calibration frequency	Every 3 year	
Previous calibration	Unknown (verified during the 1 <sup>st</sup> verification, refer to the 1 <sup>st</sup> VR)	OK
Latest calibration (Cert. No.)	14/11/2013 / E313846	OK
Applied period of max. permissible errors where applicable	N/A	

- The thermometer (TE-7106) was calibrated by the 3<sup>rd</sup> party calibration laboratory (Konics) under KOLAS (Korea Laboratory Accreditation Scheme) within validity
- The applied period of max. permissible error when applicable: N/A  
(Monitoring period is from 24/02/2011 to 31/10/2016 within validity)

3) Verification

- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan and related validation report, 1<sup>st</sup> monitoring report and 1<sup>st</sup> verification report, and the registered PDD and Validation report)
- Verification team checked whether the measuring meter was calibrated within the calibration period or not.
- Verification team reviewed the calibration results including error in the calibration certificate provided by PP.
- Verification team assessed the internal calibration procedure such as test method, test standard, qualification of tester, validity of applied standard meter<sup>/20/</sup>.

**5. NCV<sub>PG, y</sub>:**

- 1) Description: Net calorific value of purge gas
- 2) Monitoring equipment and calibration information : Not applicable  
Gas chromatograph is controlled by a standard calibration curve using the reference material (standard gas within the validity period)

**6. LF<sub>y</sub>**

- 1) Description: Quantity of by-product liquid fuel combusted in the project boiler during the year, y
- 2) Monitoring equipment and calibration information (Flow meter)

Subjects	Contents	Remarks
Type	Positive displacement	
Manufacturer	Korea Oval	
Model type	VXW-1150-N11G-1116	
Accuracy	±3.3%	
Tag No./SN	FQ_7104 / B153-6985	
Calibration entity	3 <sup>rd</sup> party calibration	
Calibration frequency	Every 3 year	
Previous calibration	24/08/2004	OK
	27/09/2011 / OKL11-09422 (3.66%)	NG
Latest calibration (Cert. No.)	22/10/2014 (FTL14-10-576) (3.28%)	NG
Applied period of max. permissible errors where applicable	From 24/02/2011 to 27/09/2011 From 28/09/2014 to 21/10/2014	CAR 05

- The LF flow meter (FQ-7104) was calibrated by the 3<sup>rd</sup> party, FLOTRO which accredited by ISO 17025.
- The previous calibration date: 27/09/2011: verified during the 1<sup>st</sup> monitoring period (refer to the 1<sup>st</sup> Verification Report)
- The applied period of max. permissible error when applicable:
  - From 24/02/2011 to 27/09/2011
  - From 28/09/2014 to 21/10/2014

**7. NCV<sub>LF, y</sub>:**

- 1) Description: Net calorific value of by-product liquid fuel
- 2) Monitoring equipment and calibration information : N/A  
**NCV<sub>LF, y</sub>** are measured by 3<sup>rd</sup> Party under KOLAS quarterly.

**8. ε<sub>project, y</sub>:**

- 1) Description: Energy efficiency of boiler during the year y
- 2) Monitoring equipment and calibration information : N/A  
**ε<sub>project, y</sub>** are calculated by the direct method (dividing the net heat generation by the energy content of the fuel combusted).

<b>Findings</b>	CL01, CAR 01, CAR 03, CAR 04 and CAR 05, refer to Appendix 4. Based on the review of revised MR and revised emission reduction spread sheet, CL01, CAR 01, CAR 03, CAR 04 and CAR 05 were properly corrected and found satisfied.
<b>Conclusion</b>	Verification team confirms followings - The calibration frequency for measuring instrument are appropriately managed as described in the revised monitoring plan <sup>/05/</sup> and the registered PDD <sup>/03/</sup> . - Internal calibration procedure are also appropriately managed by PP.

## E.8. Assessment of data and calculation of emission reductions or net removals

### E.8.1. Calculation of baseline GHG emissions or baseline net GHG removals by sinks

Means of verification

All parameters specified in the revised monitoring plan and the registered PDD have been monitored or measured as per the revised monitoring plan<sup>/05/</sup>. Therefore all parameter required to calculate the emission reductions were available. The reported data have been cross-checked with the other objective sources available.

The key parameters to calculate the emission reductions are as below;

① Fuel combusted in the project boiler during the year, y

- Natural gas( $FF_{project, y}$ ): 87,504,351 Nm<sup>3</sup>  
(before 2013: 30,902,352 Nm<sup>3</sup>, from 2013: 56,601,999 Nm<sup>3</sup>)

- Purge gas ( $PG_y$ ): 47,391,798 Nm<sup>3</sup>  
(before 2013: 12,825,597 Nm<sup>3</sup>, from 2013: 34,566,201 Nm<sup>3</sup>)

- by-product liquid ( $LF_y$ ): 51,526,436 litre  
(before 2013: 17,694,695 litres, from 2013: 33,831,742 litres)

② NCV of each fuel

- Natural gas ( $NCV_{NG, y}$ ):  $39.49 \times 10^{-6}$  TJ/Nm<sup>3</sup>  
(before 2013:  $39.65 \times 10^{-6}$  TJ/Nm<sup>3</sup>, from 2013:  $39.4 \times 10^{-6}$  TJ/Nm<sup>3</sup>)

- Purge gas ( $NCV_{WG, y}$ ):  $44.10 \times 10^{-6}$  TJ/Nm<sup>3</sup>  
(before 2013:  $57.68 \times 10^{-6}$  TJ/Nm<sup>3</sup>, from 2013:  $39.06 \times 10^{-6}$  TJ/Nm<sup>3</sup>)

- By-product liquid ( $NCV_{LF, y}$ ):  $28.28 \times 10^{-6}$  TJ/Nm<sup>3</sup>  
(before 2013:  $29.26 \times 10^{-6}$  TJ/litre, from 2013:  $27.77 \times 10^{-6}$  TJ/litre)

③ Heat production ( $Q_{total, y}$ ): 6,251.92TJ  
(before 2013: 2,123.35TJ, from 2013: 4,128.57TJ)

According to the registered PDD, the Baseline emissions are calculated as below;

$BE_y = EF_{baseline} \times Q_y$

① Before 01/01/2013

$= 89.05 \text{ tCO}_2/\text{TJ} \times 1,047.91\text{TJ} = 93,316.57$

② From 01/01/2013

$= 89.05 \text{ tCO}_2/\text{TJ} \times 3,037.03\text{TJ} = 181,397.72$

$EF_{baseline}$ : 89.05 tCO<sub>2eq</sub>/TJ (as per the registered PDD)

Period	$Q_{total, y}$ (TJ)	$Q_y$ (TJ)	Baseline Emission (tCO <sub>2</sub> )	Remarks
Before 2013	2,123.35	1,047.91	93,316.57	
From 2013	4,128.57	2,037.03	181,397.72	

	<table><tr><td>total</td><td>6,251.92</td><td>3,084.94</td><td>274,714.29</td><td></td></tr></table> <p>The heat amount of steam generated by NG in fuels (LN, purge gas and by-product liquid fuel) are calculated as follows.</p> $Q_y = Q_{total,y} \times \frac{FF_{project,y} \times NCV_{Ng,y}}{FF_{project,y} \times NCV_{NG,y} + PG_y \times NCV_{WG,y} + LF_y \times NCV_{LF}}$ <p>During the verification the calculation of baseline has been checked. In detail the following has been verified :</p> <ul style="list-style-type: none"><li>• Transparency: it has been checked whether the calculation of baseline emission is fully traceable and where used, the emission reduction spread sheet calculation<sup>/02/</sup> provides all calculation formulae.</li><li>• Parameter consistency: It has been checked whether all internal and external parameters and data used for the calculation are applied.</li><li>• Correctness: it has been checked whether the applied formulae and methods for calculation baseline emissions are in accordance with the monitoring plan in the registered PDD<sup>/03/</sup> and the applied methodology, AMS-III.B (ver.12)<sup>/09/</sup>.</li><li>• Completeness: it has been checked whether all calculations are complete and without omissions.</li></ul> <p>The following sources of information has been used in this section.</p> <ul style="list-style-type: none"><li>• Monitoring Report<sup>/01/</sup></li><li>• The revised monitoring plan<sup>/05/</sup></li><li>• Validation report of the revised monitoring plan<sup>/06/</sup></li><li>• Registered PDD<sup>/03/</sup></li><li>• Validation Report<sup>/04/</sup></li><li>• Emission reduction spread spreadsheet<sup>/02/</sup></li><li>• AMS-III.B version 12.0<sup>/09/</sup></li></ul>	total	6,251.92	3,084.94	274,714.29	
total	6,251.92	3,084.94	274,714.29			
Findings	Not applicable. No findings were raised.					
Conclusion	Verification team confirms that baseline emissions is appropriately calculated to be 274,714.29 tCO <sub>2e</sub> as per the formulae and methods described in the revised monitoring plan and the registered PDD <sup>/03/</sup> and the applied methodology <sup>/09/</sup> .					

### E.8.2. Calculation of project GHG emissions or actual net anthropogenic GHG removals by sinks

<b>Means of verification</b>	<p>The key parameters to calculate the project emissions are as below;</p> <ol style="list-style-type: none"> <li>① After the fuel switch, NG combusted in the project boiler during the year, y is 87,504,351 Nm<sup>3</sup> during the monitoring period (before 2013: 30,902,352 Nm<sup>3</sup>, from 2013: 56,601,999 Nm<sup>3</sup>)</li> <li>② NCV of natural gas (NCV<sub>NG,y</sub>): 39.49 × 10<sup>-6</sup> TJ/ Nm<sup>3</sup></li> <li>③ EF<sub>NG,CO2</sub>: 56.1 tCO<sub>2</sub>/TJ (As per the registered PDD)</li> </ol> <p>After the fuel switch, the project emission are calculated as below;</p> $PE_y = FF_{project,y} \times NCV_{NG,y} \times EF_{NG,CO2}$ <ol style="list-style-type: none"> <li>① Before 01/01/2013           <math display="block">= 30,902,352 \text{ Nm}^3 \times 39.65 \times 10^{-6} \text{ TJ/ Nm}^3 \times 56.1 \text{ tCO}_2/\text{TJ}</math> <math display="block">= 68,743.53 \text{ tCO}_2</math> </li> </ol>
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	<p>② From 01/01/2013</p> $= 56,601,999\text{Nm}^3 \times 39.40 \times 10^{-6}\text{TJ/ Nm}^3 \times 56.1\text{tCO}_2/\text{TJ}$ $= 125,109.66 \text{ tCO}_2$																
	<table><tr><th>Period</th><th>FF<sub>project,y</sub> (Nm<sup>3</sup>)</th><th>Project Emission (tCO<sub>2</sub>)</th><th>Remarks</th></tr><tr><td>Before 2013</td><td>2,123.35</td><td>68,743.53</td><td></td></tr><tr><td>From 2013</td><td>4,128.57</td><td>125,109.66</td><td></td></tr><tr><td>total</td><td>6,251.92</td><td>193,853.19</td><td></td></tr></table>	Period	FF <sub>project,y</sub> (Nm <sup>3</sup> )	Project Emission (tCO <sub>2</sub> )	Remarks	Before 2013	2,123.35	68,743.53		From 2013	4,128.57	125,109.66		total	6,251.92	193,853.19	
Period	FF <sub>project,y</sub> (Nm <sup>3</sup> )	Project Emission (tCO <sub>2</sub> )	Remarks														
Before 2013	2,123.35	68,743.53															
From 2013	4,128.57	125,109.66															
total	6,251.92	193,853.19															
	<p>The following sources of information has been used in this section.</p> <ul style="list-style-type: none"><li>• Monitoring Report<sup>/01/</sup></li><li>• The revised monitoring plan<sup>/05/</sup></li><li>• Validation report of the revised monitoring plan<sup>/02/</sup></li><li>• Registered PDD<sup>/03/</sup></li><li>• Validation Report<sup>/04/</sup></li><li>• Emission reduction spread spreadsheet<sup>/02/</sup></li></ul> <p>AMS-III.B version 12.0<sup>/09/</sup></p>																
Findings	<p>N/A</p> <p>No findings were raised.</p>																
Conclusion	<p>Verification team confirms that the project emissions are appropriately calculated to be 193,856.18 tCO<sub>2e</sub> as per the revised monitoring plan and registered PDD<sup>/03/</sup> and the applied methodology<sup>/09/</sup>.</p>																

### E.8.3. Calculation of leakage GHG emissions

<b>Means of verification</b>	According to the AMS-III.B version 12 and registered PDD, validation report and the previous monitoring report & verification report, no leakage emission (LE <sub>y</sub> ) is needed to be considered. Therefore, LE <sub>y</sub> = 0 tCO <sub>2eq</sub>
<b>Findings</b>	Not applicable No findings were raised.
<b>Conclusion</b>	Verification team confirms that no leakage emission is needed to be calculated as per the registered PDD and the applied methodology, AMS-III.B version 12.

### E.8.4. Summary calculation of GHG emission reductions or net anthropogenic GHG removals by sinks

<b>Means of verification</b>	<p>The verification team have cross-checked the GHG emission reductions calculation in the Monitoring report<sup>/01/</sup> against the ER calculation spreadsheet<sup>/02/</sup> and, the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup>.</p> <p>According to the applied methodology AMS-III.B version 12<sup>/09/</sup>, the revised monitoring plan and the registered PDD<sup>/03/</sup>, the emission reductions resulting from the project activity are calculated based on the following formula.</p> $ER_y = BE_y - PE_y - LE_y$ <p>① Before 01/01/2013</p> $= 93,316.57 \text{ tCO}_2 - 68,743.52 \text{ tCO}_2 - 0 \text{ tCO}_2$ $= 24,573.03 \text{ tCO}_2$ $\approx 24,573 \text{ tCO}_2$ <p>② From 01/01/2013</p> $= 181,397.72 \text{ tCO}_2 - 125,109.66 \text{ tCO}_2 - 0 \text{ tCO}_2$ $= 56,288.05 \text{ tCO}_2$ $\approx 56,288 \text{ tCO}_2$
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	③ Total Emission Reduction during the monitoring period is 80,861 tCO <sub>2</sub>					
	Unit: tCO <sub>2</sub>					
	Period	BE <sub>y</sub>	PE <sub>y</sub>	LE <sub>y</sub>	ER <sub>y</sub>	Remarks
	Before 2013	93,316.57	68,743.52	0	24,573.03	
	From 2013	181,397.72	125,109.66	0	56,288.05	
	Total	274,714.29	193,853.19	0	80,861	
	Where ER <sub>y</sub> : Emission Reductions in year y tCO <sub>2</sub> BE <sub>y</sub> : Baseline Emissions in year y tCO <sub>2</sub> PE <sub>y</sub> : Project Emissions in year y tCO <sub>2</sub> LE <sub>y</sub> : Leakage Emissions in year y tCO <sub>2</sub>					
	The emission reductions during this monitoring period (24/02/2011 to 31/10/2016) are calculated to be 80,861 tCO <sub>2</sub> as follows;					
	Subjects		Monitoring Periods (24/02/2011 to 31/10/2016)		Remarks	
	Baseline emissions		274,714 tCO <sub>2</sub>			
Project emissions		193,853 tCO <sub>2</sub>				
Emission Reductions		80,861 tCO <sub>2</sub>				
Findings	N/A No findings were raised.					
Conclusion	<p>KSA confirms that:</p> <ul style="list-style-type: none"> <li>All data and parameters were monitored in accordance with the revised monitoring plan and the registered PDD<sup>/03/</sup>;</li> <li>Monitoring data are verified and cross-checked;</li> <li>Complete set of data have been correctly applied to emission reduction calculation;</li> <li>Calculation of baseline, project, and leakage emission have been performed in accordance with the formula and methods described in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> and the applied methodology<sup>/09/</sup>; and,</li> </ul> <p>All assumptions, emission factors and default values applied to the calculation are appropriate.</p>					

#### E.8.5. Comparison of actual GHG emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Means of verification	Verification team have checked the estimated annual emission reductions in the revised monitoring plan <sup>/05/</sup> and the registered PDD <sup>/03/</sup> and converted the estimated reductions to annual corresponding monitoring period. Claimed emission reduction for this monitoring period 80,161 tCO <sub>2</sub> e which is much less than the estimated values in the revised monitoring plan <sup>/05/</sup> and the registered PDD.						
	Subjects	Emission Reductions (ERs)	Remarks				
	Expected ERs	111,632 tCO <sub>2</sub> eq	Year	Expected ERs in the PDD			
			2011	19,635	X	311/365	= 16,730
			2012	19,635	X	366	= 19,635
			2013	19,635	X	365	= 19,635
			2014	19,635	X	365	= 19,635
			2015	19,635	X	365	= 19,635
			2016	19,635	X	305/366	= 16,362
			Sum	111,632			

	Actual ERs	80,861tCO <sub>2eq</sub>	
	<p>Comparing with the expected emission reductions in the registered PDD, the emission reductions have been decreased during this monitoring period. Verification team confirmed that the reason for the change in the amount of emission reductions during the monitoring period compared with the ex-ante are as follows.</p> <ul style="list-style-type: none"> <li>- Consumption ratio of NG (FF<sub>project, y</sub>) were decreased.</li> <li>- Annual Steam generation (Q<sub>y</sub>) from the project boiler were decreased.</li> <li>- During this monitoring period, downtime due to maintenance was increased. Downtime was 182 days during this monitoring period.</li> </ul>		
<b>Findings</b>	N/A No findings were raised.		
<b>Conclusion</b>	Emission reductions for this monitoring period is decreased by 27.6% compared to the revised monitoring plan <sup>/05/</sup> and the registered PDD <sup>/03/</sup> . But verification team confirms that the actual of emission reductions of 80,861tCO <sub>2</sub> during this monitoring period are deemed reasonable.		

**E.8.6. Remarks on difference from estimated value in registered PDD**

<b>Means of verification</b>	<p>To identify the difference from estimated value in the registered PDD, verification team have checked the following documents</p> <ul style="list-style-type: none"> <li>- the revised approved PDD</li> <li>- the previous MR and the verification report</li> <li>- Monitoring Report including the parameters</li> <li>- emission reduction calculation spreadsheet</li> </ul> <p>The reason for the decrease in emission reduction during the corresponding monitoring period is that the consumption ratio of NG (FF<sub>project, y</sub>), Annual steam generation (Q<sub>y</sub>) and downtime period were changed compared to the ex-ante estimate at the registered PDD<sup>/03/</sup>.</p>	
<b>Findings</b>	N/A No findings were raised.	
<b>Conclusion</b>	<p>Even though the emission reductions for this monitoring period is decreased by 22% compared to the registered PDD<sup>/03/</sup>, verification team confirms that the actual of emission reductions of 80,861tCO<sub>2</sub> are deemed reasonable.</p> <p>Therefore, verification team confirms that the fluctuations in emission reduction are not caused to any errors, misstatement, or omissions.</p>	

**E.8.7. Actual GHG emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards**

<b>Means of verification</b>	<p>The emission reductions before 01/01/2013 and from 01/01/2013 during this monitoring period are as follows;</p> <ul style="list-style-type: none"> <li>- Amount achieved before 01/01/2013: 24,573 tCO<sub>2e</sub></li> <li>- Amount achieved from 01/01/2013: 56,288 tCO<sub>2e</sub></li> <li>- Total emission reduction 80,861 tCO<sub>2e</sub></li> </ul> <p>To confirm the emission reduction by period, verification team have checked the followings;</p> <ul style="list-style-type: none"> <li>- NG consumption from the project boiler by period</li> <li>- Steam generation from the project boiler by period.</li> <li>- Calculation process in spread sheet</li> </ul>
<b>Findings</b>	N/A



	No findings were raised.
<b>Conclusion</b>	The actual monitoring period does not fall into the first commitment period.

**E.9. Assessment of reported sustainable development co-benefits**

<b>Means of verification</b>	Not applicable
<b>Findings</b>	Not applicable
<b>Conclusion</b>	Not applicable

**E.10. Global stakeholder consultation**

<b>Means of verification</b>	Not applicable
<b>Findings</b>	Not applicable
<b>Conclusion</b>	Not applicable

**SECTION F. Internal quality control**

>> The draft final verification report including the verification findings before submitted to UNFCCC for request of issuance was subjected an independent internal technical review to confirm that all verification activities had been completed according to the KSA procedures.

Also the technical verifier is qualified by KSA's qualification scheme for CDM validation and verification. As a result of the internal technical review process, the verification opinion and the topic specific assessments as prepared by the verification team may be confirmed or revised.

**SECTION G. Verification opinion**

>> Korean Standards Association (KSA) has performed the verification of the emission reductions reported for the project activity "LG Chem Naju plant fuel switching project" in Korea, UNFCCC reference number 2475, for the period 24/02/2011 to 31/10/2016, with regard to the relevant requirements for CDM project activities.

Project participants of the "LG Chem Naju plant fuel switching project" are responsible for;

- The preparation of GHG emission data and the reported GHG emission reductions from the project activity on the basis set out in the monitoring plan contained in the registered PDD version 10.4 dated 29/05/2009.
- The development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of GHG emission reductions of the project activity.

It is the responsibility of KSA to express an independent verification opinion about the project activity's conformity with the requirements of paragraph 62 of CDM modalities and procedures and on the reported GHG emission reductions from the project activity.

Based on the documented evidence and corroborated by an on-site assessment, KSA confirms that;

- All operations of the project activity are implemented and installed as planned in the registered and approved PDD<sup>/03/</sup>.
- The installed equipment essential for generating emission reductions run reliable and are calibrated appropriately.
- The monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable CDM requirements.
- Monitoring system are in place and functional
- Monitoring complies with the monitoring plan in the revised monitoring plan<sup>/05/</sup> and the registered PDD.
- The monitoring plan in the revised monitoring plan<sup>/05/</sup> and the registered PDD<sup>/03/</sup> is as per the applied baseline and monitoring methodology.

In KSA's opinion, the project's reported GHG emission reductions for the period from 24/02/2011 to 31/10/2016, as reported in the Monitoring Report version 3.0 dated 02/03/2018 for the project activity, is fairly sated. The emission reductions have been correctly calculated without material misstatements on the basis

of the approved monitoring methodology AMS-IIIB version 12.0 and the monitoring plan and formulae given in the registered PDD.

## SECTION H. Certification statement

>> Korean Standards Association (KSA) has performed the verification of the registered CDM project "LG Chem Naju plant fuel switching project (reference no: 2475)" in Republic of Korea for 2<sup>nd</sup> monitoring period from 24/02/2011 to 31/10/2016.

The verification consisted of the following three phases;

- i ) desk review of the revised monitoring plan<sup>/05/</sup> and the registered project design document, applied baseline and monitoring methodology version 12.0, monitoring report and additional documents provided by the PP;
- ii ) on-site assessment and interviews with the project participants;
- iii) resolution of outstanding issues and the issuance of the of the final verification report and statements.

The project participant is responsible for the preparation of the GHG emissions data and the reported GHG emission reductions on the basis set out within the monitoring plan indicated in the registered Project design document.

This verification has been conducted based on the monitoring report dated 02/08/2017, the final monitoring report(version 3.0) dated 02/03/2018, monitoring plan as described in the revised monitoring plan and the registered PDD, validation report, emission reductions calculation spreadsheet and supporting documents made available to KSA by the project participant.

The GHG emission reductions were correctly calculated without material misstatements based on the approved monitoring methodology AMS-III.B version 12.0 and the monitoring plan contained in the registered PDD. Hence, Korean Standards Association certifies that the reported emission reductions from the project activity equated to 80,861tCO<sub>2e</sub>.

## Appendix 1. Abbreviations

Abbreviations	Full texts
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
CO <sub>2</sub>	Carbon Dioxide
EB	Executive Board
EF	Emission Factor
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
K-ETS	Korea Emission Trading scheme
KSA	Korean Standards Association
MP	Monitoring Plan
NCV	Net Calorific value
NG	Natural Gas
PDD	Project Design Document
PE	Project Emissions
PIS	Plant Information Management System
PG	Purge gas
QA/QC	Quality Assurance/Quality Control
VVS	Clean Development Mechanism Validation and Verification Standard

## Appendix 2. Competence of team members and technical reviewers

Name	Mr. Sohn, Kyull	Mr. Han, WonCheol	Mr. Moon, HyunMan	Mr. Choi, SeungKeun
Role	Verification team leader	Verifier	Trainee	Technical Reviewer
Competence in relevant sector	Competent in sector 1	Competent in sector 1	N/A	Competent in sector 1
Responsibility	Document review, Interview, Findings, resolution & VR preparation	Document review, Interview, Findings & resolution	Document review, Interview, Findings & resolution	Technical Review

# KSA

## GHG Validator/Verifier Certificate

Kyull Sohn

Certificate No. : CDM-001

Technical Area : 1.1, 1.2, 2.1, 3.1, 13.1, 13.2

Korean Standards Association hereby certifies that the above person is qualified by KSA's Qualification requirements to conduct validation and verification for CDM and GHG project.

VALID FROM

2016.04.04

VALID UNTIL

2019.04.03

PRESIDENT OF KSA

*Baek, Soo Hyun*

**KOREAN STANDARDS ASSOCIATION**

20F, Kotech Center Bldg, 305 Teheran-ro, Gangnam-gu, Seoul, Korea

# KSA

## CDM Verifier/Technical Expert Certificate

WonCheol Han

Certificate No. : CDM-021

Technical Area : 1.2, 2.1, 3.1, 9.2, 10.1, 13.1

Korean Standards Association hereby certifies that the above person is qualified by KSA's Qualification requirements to conduct Verification for CDM and GHG project.

VALID FROM

2012.04.04

VALID UNTIL

2019.04.03

PRESIDENT OF KSA

*Baek, Soo Hyun*

**KOREAN STANDARDS ASSOCIATION**

20F, Kotech Center Bldg, 305 Teheran-ro, Gangnam-gu, Seoul, Korea

# KSA

## CDM Validator/Verifier Certificate

HyunMan Moon

Certificate No. : CDM-030

Technical Area :

Korean Standards Association hereby certifies that the above person is qualified by KSA's Qualification requirements to conduct validation and verification for CDM and GHG project.

VALID FROM

2017.03.01

VALID UNTIL

2020.02.28

PRESIDENT OF KSA

*Baek, Soo Hyun*

**KOREAN STANDARDS ASSOCIATION**

20F, Kotech Center Bldg, 305 Teheran-ro, Gangnam-gu, Seoul, Korea

# KSA

## GHG Validator/Verifier Certificate

SeungKeun Choi

Certificate No. : CDM-015

Technical Area : 1.1, 1.2, 2.1, 3.1, 13.1, 13.2

Korean Standards Association hereby certifies that the above person is qualified by KSA's Qualification requirements to conduct validation and verification for CDM and GHG project.

VALID FROM

2016.04.04

VALID UNTIL

2019.04.03

PRESIDENT OF KSA

*Baek, Soo Hyun*

**KOREAN STANDARDS ASSOCIATION**

20F, Kotech Center Bldg, 305 Teheran-ro, Gangnam-gu, Seoul, Korea

### Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
1	PP	Monitoring Report for LG Chem Naju plant (initial version 1.0, 21/05/2017 and final version 3.0, 02/03/2018)	/01/	PP
2	PP	Emission reductions calculation spreadsheet (initial version 1.0, 21/05/2017 and final version 3.0, 02/03/2018)	/02/	PP
3	PP	Registered PDD (V10.04)	/03/	Others
4	KFQ	Validation Report	/04/	Others
5	PP	Revised monitoring plan	/05/	Others
6	KFQ	Validation report of revised monitoring plan	/06/	Others
7	PP	1 <sup>st</sup> Monitoring Report	/07/	Others
8	KFQ	1 <sup>st</sup> Verification Report	/08/	Others
9	CDM EB	AMS-III.B. (version 12.0)	/09/	Others
10	CDM EB	Monitoring report form (CDM-MR-FORM)	/10/	Others
11	CDM EB	CDM Validation and Verification standard for project activities. (version 1.0)	/11/	Others
12	CDM EB	Guideline on the application of materiality in verifications. (version 2.0)	/12/	Others
13	PP	Raw data from PIS data (monthly) - Steam generated by the project boiler - Consumption of NG. - Consumption of Purge gas - Consumption of by-product liquid fuel	/13/	PP
14	PP	Weighted average net calorific value calculation spread sheet. - Natural gas - Purge gas - by-product liquid fuel	/14/	PP
15	PP	Daily operation record for 70 ton/h boiler	/15/	PP
16	PP	Annual plant Shut down for maintenance.	/16/	PP
17	PP	Calibration certificate for natural gas flow meter - Dated 05/11/2010 Certificate No. OKL10-11-133 by FLOTRON - Dated 04/11/2013 Certificate No. OKL13-11-213 by FLOTRON  Calibration certificate for natural gas thermometer. - Dated 14/11/2013 Certi. No. E313845 by 3 <sup>rd</sup> Party, KONICS	/17/	PP
18	PP	Calibration certificate for purge gas flow meter - Dated 11/09/2010 (internal calibration) - Dated 26/09/2011 (internal calibration) - Dated 10/09/2012 (internal calibration) - Dated 03/11/2013 (internal calibration) - Dated 29/10/2014 (internal calibration) - Dated 15/11/2015 (internal calibration) - Dated 16/04/2016 (internal calibration)	/18/	PP
19	PP	Calibration certificate for by-product liquid fuel flow meter. - Dated 27/09/2011 Certificate No. OKL11-09-422 by FLOTRON (3 <sup>rd</sup> Party) - Dated 22/10/2014 Certificate No. FTL14-10-576 by FLOTRON (3 <sup>rd</sup> Party)	/19/	PP
20	PP	Calibration certificate for steam flow meter - Dated 11/09/2010 (internal calibration)	/20/	PP



		<ul style="list-style-type: none"> <li>- Dated 26/09/2011 (internal calibration)</li> <li>- Dated 10/09/2012 (internal calibration)</li> <li>- Dated 03/11/2013 (internal calibration)</li> <li>- Dated 29/10/2014 (internal calibration)</li> <li>- Dated 15/11/2015 (internal calibration)</li> <li>- Dated 16/04/2016 (internal calibration)</li> </ul> <p>Calibration certificate for steam thermometer.</p> <ul style="list-style-type: none"> <li>- Dated 02/08/2012 Certi. No. E209387 by 3<sup>rd</sup> Party KONICS</li> <li>- Dated 13/04/2016 Certi. No. 20160406009 by 3<sup>rd</sup> Party KONICS.</li> </ul>		
21	PP	<p>Standard equipment specification (Digital Multi-meter, S/N: 6210191) used for internal calibration</p> <ul style="list-style-type: none"> <li>- Certi. No.: 12-7356-07 (dated 08/05/2012) by 3<sup>rd</sup> Party, KMIRA</li> <li>- Certi. No.: KM13-7360-003 (dated 25/09/2013) by 3<sup>rd</sup> Party, KRC</li> <li>- Certi. No.: KM14-8635-001 (dated 22/11/2014) by 3<sup>rd</sup> Party, KRC</li> <li>- Certi. No.: KM15-3158-007 (dated 04/05/2015) by 3<sup>rd</sup> Party, KRC</li> <li>- Certi. No.: KM16-3575-005 (dated 27/05/2016) by 3<sup>rd</sup> Party, KRC</li> </ul>	/21/	PP
22	PP	CDM Operation Manual for LG Chem Naju plant	/22/	PP
23	Government of Korea	Energy Act	/23/	Others
24	Government of Korea	Guideline for development of heat factor and emission factor.	/24/	Others
25	Government of Korea	Guideline for Korea's emission trading scheme.	/25/	Others
26	PP	PG gas fuelization project report	/26/	PP
27	PP	Inventory Report for Naju plant under K-ETS (from 2011 to 2016)	/27/	PP
28	NG Supplier	NG Bill by NG Supplier(Haeyang City Gas Co. Ltd)	/28/	PP

## Appendix 4. Clarification requests, corrective action requests and forward action requests

**Table 1. Remaining FAR from validation and/or previous verifications**

FAR ID	N/A	Section no.	N/A	Date: DD/MM/YYYY
<b>Description of FAR</b>				
N/A				
<b>Project participant response</b>				Date: DD/MM/YYYY
N/A				
<b>Documentation provided by project participant</b>				
N/A				
<b>DOE assessment</b>				Date: DD/MM/YYYY
N/A				

**Table 2. CL from this verification**

CL ID	CL01	Section no.	E.7.0	Date: 01/09/2017
<b>Description of CL</b>				
Please submit the calibration certificates for LNG meter (FQ-7105) to verification team.				
<b>Project participant response</b>				Date: 10/10/2017

PP send the calibration certificate of NG flow meter (FQ-7105)	
<b>Documentation provided by project participant</b>	
<i>Two calibration certificate for natural gas flow meter (FQ-7105)</i> - dated 05/11/2010 certification No.OKL-10-11-133 by FLOTRON (3 <sup>rd</sup> party calibration body) - dated 04/11/2013 certification No.OKL-13-11-213 by FLOTRON (3 <sup>rd</sup> party calibration body)	
<b>DOE assessment</b>	<b>Date:</b> 23/10/2017
<p>Verification team checked two calibration certificate provided by PP as follows;</p> <p>1) dated 05/11/2010 certificate: verified during the 1<sup>st</sup> monitoring period</p> <p>2) dated 14/11/2013 certificate was checked as follows;</p> <ul style="list-style-type: none"> <li>- As per the revised monitoring plan, calibration frequency for the natural gas flow meter (FQ-7105) is 3 years.</li> <li>- The measuring instrument for the natural gas flow meter (FQ-7105) was calibrated within the specified calibration frequency in the revised monitoring plan.</li> <li>- SN: C15-S0728HN (FQ-7105)</li> <li>- The natural gas flow meter (FQ-7105) were calibrated by 3<sup>rd</sup> party accredited by ISO 17025.</li> <li>- Measurement uncertainty: max. 0.42% which are within the range of accuracy 1% specified in the revised monitoring plan.</li> </ul> <p>Thus, CL01 was checked and satisfied. CL 01 is closed.</p>	

<b>CL ID</b>	CL02	<b>Section no.</b>	E.6.2	<b>Date:</b> 01/09/2017
<b>Description of CL</b>				
<p>The energy efficiency of the project boiler during the monitoring period are highly fluctuated and also lower than the value in the revised monitoring plan. Please explain the reasons to verification team.</p>				
<b>Project participant response</b>				<b>Date:</b> 10/10/2017
<p>Energy efficiency of the project boiler are calculated by the direct method (dividing the net heat generation by the energy content of the fuels combusted in the project boiler). The main variables of energy efficiency are attributed to the economizer and air preheater and are associated with their cleaning cycle.</p> <p>Some energy efficiency of the project boiler (Apr 2012, Sep 2012) were wrongly calculated due to the delayed cleaning the boiler. Recalculate overall energy efficiency of the project boiler and revised the errors.</p>				
<b>Documentation provided by project participant</b>				
N/A				
<b>DOE assessment</b>				<b>Date:</b> 23/10/2017
<p>Verification team checked the energy efficiency of the project boiler and it was appropriate.</p> <p>The range of the energy efficiency in the project boiler was similar to the energy efficiency of a general boiler in other plant.</p> <p>Thus, CL02 was checked and satisfied. CL 02 is closed.</p>				

<b>CL ID</b>	CL03	<b>Section no.</b>	E.3.0	<b>Date:</b> 01/09/2017
<b>Description of CL</b>				
<p>The variation in PG Net calorific value (<math>NCV_{WG,y}</math>) in the MR (version 01) were very high. Please explain the reason.</p>				
<b>Project participant response</b>				<b>Date:</b> 10/10/2017
<p>Purge gas is generated in the process of octanol production. It is composed of C3H6, C3H8, H2, etc., and its composition may be changed according to the operation situation. The reason for the change in calorific value is that the dilution ratio has changed. After April 8, 2014, consumption of purge gas increased and calories decreased.</p> <p>(See Purge gas fuelization project report on 16/05/2014).</p>				
<b>Documentation provided by project participant</b>				
Purge gas fuelization project report on 16/05/2014				

<b>DOE assessment</b>	<b>Date:</b> 23/10/2017
<p>Verification team checked the project report and the NCV and quantity of the purge gas in the emission reductions calculation spreadsheet.</p> <p>As per "Purge gas fuelization project report"<sup>26/n</sup>, improvement of the purge gas operating system has reduced the flaring loss that was thrown away. As a result, the ratio of C3H3 decreased and the ratio of H2 increased. The quantity of purge gas increased, but the NCV of purge gas decreased. Therefore the total calories were similar to the previous. Since total calories is similar to the past, they did not actually affect the emission reductions of this project activity.</p> <p>Thus, CL03 was checked and satisfied. CL 03 is closed.</p>	

<b>CL ID</b>	CL04	<b>Section no.</b>	E.7.0	<b>Date:</b> 01/09/2017
<b>Description of CL</b>				
The pressure gauge (PT-7105) installed at the boiler and the pressure gauge specified in the 1 <sup>st</sup> verification report are different. Please explain the reason.				
<b>Project participant response</b>				<b>Date:</b> 10/10/2017
The pressure gauge specified in the 1 <sup>st</sup> verification report is misleading information that is different from the actual one. We, PP, send the pressure gauge photograph which checked on-site and the calibration report.				
<b>Documentation provided by project participant</b>				
<ul style="list-style-type: none"> <li>- Pressure gauge photographs</li> <li>- Calibration report for the pressure gauge.(FY 2010, FY 2013 and FY 2016)</li> </ul>				
<b>DOE assessment</b>				<b>Date:</b> 23/10/2017
<p>Verification team checked the pressure gauge at on-site inspection. And the verification team checked that there are consistency between the pressure gauge information installed on-site and the the information in the calibration report.</p> <p>Thus, CL04 was checked and satisfied. CL 04 is closed.</p>				

Table 3. CAR from this verification

CAR ID	CAR 01	Section no.	E.7.0	Date: 01/09/2017
Description of CAR				
According to the revised monitoring plan, the NG meter (FQ-7105) shall be calibrated by every 3 years. The latest calibration date for NG meter (FQ-7105) is 04/11/2013. Therefore the quantity of NG from 06/11/2016 to 31/12/2016 were measured over the specified calibration frequency				
Project participant response				Date: 02/03/2018
PP modified the monitoring cycle within the calibration validity and applied for the emission reduction in the corresponding period as below;				
Before		After		
Monitoring period: 24/02/2011 ~ 31/12/2016		Monitoring period: 24/02/2011 ~ 31/10/2016		
PP revised the revised MR and the emission reductions spread sheet due to the change of the monitoring period.				
Documentation provided by project participant				
N/A				
DOE assessment				Date: 09/03/2018

Verification team checked the activity data such as steam generation, consumption of natural gas, purge gas and liquid fuel at on-site from 24/02/2011 to 31/12/2016 monthly data.

Changes in activity data (consumption of natural gas, purge gas and liquid fuel) due to monitoring period changes are as follows;

Subjects	Before	After
Monitoring period	24/02/2011 to 31/12/2016	24/02/2011 to 31/12/2016
Natural gas ( $FF_{project,y}$ )	90,442,886 Nm <sup>3</sup>	87,504,351 Nm <sup>3</sup>
Purge gas ( $PG_y$ )	48,386,295 Nm <sup>3</sup>	47,317,827 Nm <sup>3</sup>
By-product liquid fuel ( $LF_y$ )	52,778,969 litre	51,269,3499 litre
Steam generated ( $Q_{total,y}$ )	2,382,401 ton	2,314,3571 ton

After the monitoring period change, the above activity data did not take into account the adjustment due to the delayed calibration. PP have appropriately re-calculated the emission reductions in the MR and spreadsheet using the changed activity data. Thus, CAR 01 was checked and satisfied. CAR 01 is closed.

<b>CAR ID</b>	CAR 02	<b>Section no.</b>	E.6.2	<b>Date:</b> 01/09/2017																
<b>Description of CAR</b>																				
NCV for natural gas ( $NCV_{NG,y}$ ) was changed on 30/12/2016 as per "standard manual for calorific value" in "the Energy Act" of Korea. But pp has not considered the change of the NCV for natural gas at the emission reduction in the MR.																				
<b>Project participant response</b>				<b>Date:</b> 02/03/2018																
NCV for natural gas ( $NCV_{NG,y}$ ) was applied 40.0MJ/Nm <sup>3</sup> until 31/12/2011. And it was applied to 39.4 0MJ/Nm <sup>3</sup> from 01/01/2012 when the law come into effect. The final calorific value was the weighted average value considering the fuel consumption of period by two NCV values as follows;																				
<table border="1"> <thead> <tr> <th>Period</th><th>NG Consumptions (Nm<sup>3</sup>)</th><th>Applied NCV (MJ/Nm<sup>3</sup>)</th><th>Remarks</th></tr> </thead> <tbody> <tr> <td>24/02/2011 to 31/12/2011</td><td>13,037,029</td><td>40.00</td><td></td></tr> <tr> <td>01/01/2012 to 31/10/2016</td><td>74,467,322</td><td>39.40</td><td></td></tr> <tr> <td>Total/weighted average</td><td>87,504,351</td><td>39.49</td><td></td></tr> </tbody> </table>					Period	NG Consumptions (Nm <sup>3</sup> )	Applied NCV (MJ/Nm <sup>3</sup> )	Remarks	24/02/2011 to 31/12/2011	13,037,029	40.00		01/01/2012 to 31/10/2016	74,467,322	39.40		Total/weighted average	87,504,351	39.49	
Period	NG Consumptions (Nm <sup>3</sup> )	Applied NCV (MJ/Nm <sup>3</sup> )	Remarks																	
24/02/2011 to 31/12/2011	13,037,029	40.00																		
01/01/2012 to 31/10/2016	74,467,322	39.40																		
Total/weighted average	87,504,351	39.49																		
<b>Documentation provided by project participant</b>																				
N/A																				
<b>DOE assessment</b>				<b>Date:</b> 09/03/2018																
Verification team have checked the NG consumption by period and "standard manual for calorific value" in the "Energy Act" of Korea including the effective date. Verification team confirmed that the weighted average was appropriately calculated and applied into the emission calculation spreadsheet and MR. Thus, CAR 02 was checked and satisfied. CAR 02 is closed.																				

<b>CAR ID</b>	CAR 03	<b>Section no.</b>	E.7.0	<b>Date:</b> 01/09/2017
<b>Description of CAR</b>				
According to the internal calibration procedure (CDM Operation Manual ver. 1.0), the calibration frequency for the purge gas flow meter (FQ-7106) is 1 year, but this purge gas flow meter was delayed for the following period during this monitoring period. .				
1) 12/09/2011 to 25/09/2011 2) 11/09/2013 to 03/11/2013 3) 30/10/2015 to 14/11/2015				
However, PP did not apply the conservative emission reduction in this monitoring period, taking into account the replacement or calibration date for this measurement instrument.				

Project participant response	Date: 02/03/2018																														
<p>Information for the purge gas flow meter are as below</p> <ul style="list-style-type: none"> <li>- Tag No: FQ-7106</li> <li>- Manufacture: FUJI</li> <li>- Model: EJA110A style S1</li> <li>- Type: Differential pressure type flowmeter</li> <li>- Accuracy: <math>\pm 2.0\%</math> (the information specified at the 1<sup>st</sup> Monitoring Report was misleading information)</li> <li>- Calibration frequency: every year</li> <li>- Calibration type: internal calibration</li> </ul> <p>The measured values due to the delayed calibration were adjusted as below.</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Delayed period</th> <th>Uncertainty (Cali. results)</th> <th>measured value</th> <th>adjusted value</th> <th>Error value</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>12/09/2011 to 25/09/2011</td> <td>0.42%</td> <td>435,176</td> <td>443,880</td> <td>8,704</td> <td>2%</td> </tr> <tr> <td>11/09/2013 to 03/11/2013</td> <td>0.8%</td> <td>1,408,453</td> <td>1,436,622</td> <td>28,169</td> <td>2%</td> </tr> <tr> <td>30/10/2015 to 14/11/2015</td> <td>0.5%</td> <td>1,854,901</td> <td>1,891,999</td> <td>37,098</td> <td>2%</td> </tr> <tr> <td>Total</td> <td></td> <td>3,698,530</td> <td>3,772,501</td> <td>73,971</td> <td></td> </tr> </tbody> </table> <p>To calculate the emission reduction in a conservative manner, it applied to all data for the month in which the date is included. As the error was smaller than the maximum permissible error (<math>\pm 2\%</math>), the adjusted value for the measured value was applied the maximum permissible error of meter (<math>\pm 2\%</math>) during the delayed calibration. The adjusted value is marked in red on the Emission Reduction spreadsheet.</p>		Delayed period	Uncertainty (Cali. results)	measured value	adjusted value	Error value	Remarks	12/09/2011 to 25/09/2011	0.42%	435,176	443,880	8,704	2%	11/09/2013 to 03/11/2013	0.8%	1,408,453	1,436,622	28,169	2%	30/10/2015 to 14/11/2015	0.5%	1,854,901	1,891,999	37,098	2%	Total		3,698,530	3,772,501	73,971	
Delayed period	Uncertainty (Cali. results)	measured value	adjusted value	Error value	Remarks																										
12/09/2011 to 25/09/2011	0.42%	435,176	443,880	8,704	2%																										
11/09/2013 to 03/11/2013	0.8%	1,408,453	1,436,622	28,169	2%																										
30/10/2015 to 14/11/2015	0.5%	1,854,901	1,891,999	37,098	2%																										
Total		3,698,530	3,772,501	73,971																											
<b>Documentation provided by project participant</b>																															
<ul style="list-style-type: none"> <li>- Calibration Reports<sup>7/18/</sup> for the purge gas flow meter</li> <li>- Calibration report<sup>2/1/</sup> for Standard meter (digital multi-meter, S/N: 6210191) used for internal calibration.</li> </ul>																															
<b>DOE assessment</b>																															
<p>Date: 09/03/2018</p> <p>To adjust the measured values due to the calibration delay, the verification team checked the following.</p> <ol style="list-style-type: none"> <li>1) Calibration record               <ul style="list-style-type: none"> <li>- Calibration report on 11/09/2010</li> <li>- Calibration report on 26/09/2011 (uncertainty 0.42% within permissible error, delayed calibration)</li> <li>- Calibration report on 10/09/2012 (uncertainty 0.1% within permissible error, within the validity period)</li> <li>- Calibration report on 04/11/2013 (uncertainty 0.8% within permissible error, delayed calibration)</li> <li>- Calibration report on 29/10/2014 (uncertainty 0.5% within permissible error, within the validity period)</li> <li>- Calibration report on 15/11/2015 (uncertainty 0.5% within permissible error, delayed calibration)</li> </ul> </li> <li>2) Applying the adjusted value on the ER spreadsheet and MR.</li> <li>3) Conservative estimation               <ul style="list-style-type: none"> <li>- For the purge gas, the emission reductions decrease as the consumption of the purge gas increase.</li> <li>- The adjusted value is 22,370Nm3 and the resulting emission reductions are reduced about 160tCO<sub>2</sub>.</li> </ul> </li> <li>4) Finally, verification team checked the ER spreadsheet and Monitoring Report.</li> </ol> <p>Verification team concluded that PP had appropriately carried out the adjusted values due to the delayed calibration and applied to the Emission Reduction spreadsheet and Monitoring Report. Thus CAR 03 was checked and satisfied. CAR 03 is closed.</p>																															

<b>CAR ID</b>	CAR 04	<b>Section no.</b>	E.7.0	<b>Date:</b> 01/09/2017																															
<b>Description of CAR</b>																																			
<p>According to the internal calibration procedure (CDM Operation Manual ver. 1.0), the calibration frequency for the steam flow meter (FQ-7102) is 1 year, but the steam flow meter was delayed for the following period during this monitoring period. .</p> <ol style="list-style-type: none"> <li>1) 12/09/2011 to 25/09/2011</li> <li>2) 11/09/2013 to 02/11/2013</li> <li>3) 30/10/2015 to 14/11/2015</li> </ol> <p>However, PP did not apply the conservative emission reduction in this monitoring period due to the delayed calibration.</p>																																			
<b>Project participant response</b>					<b>Date:</b> 02/03/2018																														
<p>Information for the steam flow meter are as below</p> <ul style="list-style-type: none"> <li>- Tag No: FQ-7102</li> <li>- Manufacture : Honeywell</li> <li>- Model: STD924-E1H-00000-S2.MB.SM.GC.F1.3D-B77P</li> <li>- Type: Differential pressure orifice</li> <li>- Accuracy: <math>\pm 1.0\%</math> (the information specified at the 1<sup>st</sup> Monitoring Report was misleading information)</li> <li>- Calibration frequency: every year</li> <li>- Calibration type: internal calibration</li> </ul> <p>The measured values due to the delayed calibration were adjusted as below.</p> <table border="1"> <thead> <tr> <th>Delayed period</th> <th>Uncertainty (Cali. results)</th> <th>measured value</th> <th>adjusted value</th> <th>Error value</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td>12/09/2011 to 25/09/2011</td> <td>0.2%</td> <td>24,724</td> <td>24,477</td> <td>-247</td> <td>2%</td> </tr> <tr> <td>11/09/2013 to 02/11/2013</td> <td>0.1%</td> <td>76,542</td> <td>75,777</td> <td>-765</td> <td>2%</td> </tr> <tr> <td>30/10/2015 to 14/11/2015</td> <td>0.7%</td> <td>68,892</td> <td>68,203</td> <td>-689</td> <td>2%</td> </tr> <tr> <td>Total</td> <td></td> <td>170,158</td> <td>168,456</td> <td>-1,701</td> <td></td> </tr> </tbody> </table> <p>To calculate the emission reduction in a conservative manner, the adjusted values were applied to all data for the month in which the date is included. As the error was smaller than the maximum permissible error (<math>\pm 1\%</math>), the adjusted value for the measured value was applied the maximum permissible error of meter (<math>\pm 1\%</math>) during the delayed calibration. The adjusted value is marked in red on the Emission Reduction spreadsheet.</p>						Delayed period	Uncertainty (Cali. results)	measured value	adjusted value	Error value	Remarks	12/09/2011 to 25/09/2011	0.2%	24,724	24,477	-247	2%	11/09/2013 to 02/11/2013	0.1%	76,542	75,777	-765	2%	30/10/2015 to 14/11/2015	0.7%	68,892	68,203	-689	2%	Total		170,158	168,456	-1,701	
Delayed period	Uncertainty (Cali. results)	measured value	adjusted value	Error value	Remarks																														
12/09/2011 to 25/09/2011	0.2%	24,724	24,477	-247	2%																														
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Total		170,158	168,456	-1,701																															
<b>Documentation provided by project participant</b>																																			
<ul style="list-style-type: none"> <li>- Calibration Reports<sup>20/</sup> for the steam flow meter</li> <li>- Calibration report<sup>21/</sup> for Standard meter (digital multi-meter, S/N: 6210191) used for internal calibration</li> </ul>																																			
<b>DOE assessment</b>					<b>Date:</b> 09/03/2018																														

To adjust the measured values due to the calibration delay, the verification team checked the following.

1) Calibration record

- Calibration report on 11/09/2010
- Calibration report on 26/09/2011 (uncertainty 0.2% within permissible error, delayed calibration)
- Calibration report on 10/09/2012 (uncertainty 4.9% beyond permissible error, within the validity period)
- Calibration report on 03/11/2013 (uncertainty 0.1% within permissible error, delayed calibration)
- Calibration report on 09/10/2014 (uncertainty 0.2% within permissible error, within the validity period)
- Calibration report on 15/11/2015 (uncertainty 0.7% within permissible error, delayed calibration)

2) Applying the adjusted value on the ER spreadsheet and MR.

3) Conservative estimation

- For the quantity of steam generation, the emission reductions decrease as the generated steam decrease.
- The adjusted value is (-) 1,701 ton and the resulting emission reductions are reduced about 202 tCO<sub>2</sub>.

4) Finally, verification team checked the ER spreadsheet and Monitoring Report.

Verification team concluded that PP had appropriately carried out the adjusted values due to the delayed calibration and applied to the Emission Reduction spreadsheet and Monitoring Report.

Thus CAR 04 was checked and satisfied. CAR 04 is closed.

<b>CAR ID</b>	CAR 05	<b>Section no.</b>	E.7.0	<b>Date:</b> 01/09/2017
<b>Description of CAR</b>				
<p>According to the internal calibration procedure (CDM Operation Manual ver. 1.0), the calibration frequency for the by-product liquid fuel flow meter (FQ-7104) is 3 years, but the by-product liquid flow meter was delayed for the following period during this monitoring period. .</p> <p>1) 24/02/2011 to 26/09/2011</p> <p>2) 28/09/2014 to 21/10/2014</p> <p>However, PP did not apply the conservative emission reduction in this monitoring period due to the delayed calibration.</p>				
<b>Project participant response</b>				<b>Date:</b> 02/03/2018

Information for the by-product liquid flow meter are as below

- Tag No: FQ-7104
- Manufacture : Korea Oval
- Model: LB532-141-F312-000
- Type: PD Meter
- Accuracy:  $\pm 3.3\%$  (the information specified at the 1<sup>st</sup> Monitoring Report was misleading information)
- Calibration frequency: 3 years
- Calibration type: 3<sup>rd</sup> Party calibration

The measured values due to the delayed calibration were adjusted as below.

Delayed period	Uncertainty (Cali. results)	measured value	adjusted value	Error value	Remarks
24/02/2011 to 26/09/2011	3.66%	5,696,493	5,904,985	208,492	3.6%
28/09/2014 to 21/10/2014	3.28%	1,472,597	1,521,193	48,596	3.3%
Total		7,169,090	7,426,177	257,087	

For 24/02/2011 to 26/09/2011, the error identified in the delayed calibration (3.6%) was applied to the ER as the error was beyond the maximum permissible error of the meter (3.3%). For 28/09/2014 to 21/10/2014, as the error (3.28%) was smaller than the maximum permissible error ( $\pm 3.3\%$ ), the adjusted value for the measured value was applied the maximum permissible error of meter ( $\pm 3.28\%$ ) during the delayed calibration. To calculate the emission reduction in a conservative manner, the adjusted values were applied to all data for the month in which the date is included.

The adjusted value is marked in red on the Emission Reduction spreadsheet

#### Documentation provided by project participant

- Calibration Reports <sup>7/9</sup> for the by-product liquid flow meter

#### DOE assessment

Date: 09/03/2018

To adjust the measured values due to the calibration delay, the verification team checked the following.

1) Calibration record

- Calibration report on 27/09/2011 (uncertainty 3.66% beyond permissible error, delayed calibration)
- Calibration report on 22/10/2014 (uncertainty 3.28% within permissible error, delayed calibration)

2) Applying the adjusted value on the ER spreadsheet and MR.

3) Conservative estimation

- For the quantity of steam generation, the emission reductions decrease as the generated steam decrease.
- The adjusted value is 257,087 litres and the resulting emission reductions are reduced about 282 tCO<sub>2</sub>.

4) Finally, verification team checked the ER spreadsheet and Monitoring Report.

Verification team concluded that PP had appropriately carried out the adjusted values due to the delayed calibration and applied to the Emission Reduction spreadsheet and Monitoring Report.

Thus CAR 05 was checked and satisfied. CAR 05 is closed.

CAR ID	CAR 06	Section no.	E.1.0	Date: 01/09/2017
Description of CAR				
PP have completed the Monitoring Report using the previous version 05.1 that are not the valid version of the applicable monitoring report form.				
Project participant response				Date: 02/03/2018
We revised the monitoring report using the latest reporting template CDM-MR-FORM (version 06.0).				



<b>Documentation provided by project participant</b>	
N/A	
<b>DOE assessment</b>	<b>Date:</b> 09/03/2018
<p>Verification team checked the monitoring report whether the latest reporting template applied. PP applied appropriately the latest reporting template CDM-MR-FORM (version 06.0). Thus, CAR 06 is checked and satisfied. CAR 06 is closed.</p>	

Table 4. FAR from this verification

<b>FAR ID</b>	N/A	<b>Section No.</b>	N/A	<b>Date:</b> DD/MM/YYYY
<b>Description of FAR</b>				
N/A				
<b>Project participant response</b>				<b>Date:</b> DD/MM/YYYY
N/A				
<b>Documentation provided by project participant</b>				
N/A				
<b>DOE assessment</b>				<b>Date:</b> DD/MM/YYYY
N/A				

## Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
02.1	11 January 2018	Editorial revision to correct the numbering of appendices in the instructions.
02.0	31 October 2017	Revision to align with the requirements of the "CDM validation and verification standard for project activities" (version 01.0).
01.0	23 March 2015	Initial publication.

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