Verification and certification report form for CDM project activities

(Version 03.0)

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

BASIC INFORMATION	
Title and UNFCCC reference number of the project activity	LG Chem Naju plant fuel switching project (Ref. 2475)
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the verification and certification report	Version 1.1
Completion date of the verification and certification report	24/12/2019
Monitoring period number and duration of this monitoring period	3rd monitoring period, 01/11/2016~ 03/06/2019
Version number of the monitoring report to which this report applies	2.1
Crediting period of the project activity corresponding to this monitoring period	Fixed crediting period: 04/06/2009 to 03/06/2019
Project participants	LG Chem, Ltd.
Host Party	Republic of Korea
Applied methodologies and standardized baselines	AMS-III.B. Switching fossil fuel (version 12.0)
Mandatory sectoral scopes	Sectoral scope 1 - Energy Industries (Renewable-/non-renewable)
Conditional sectoral scopes, if applicable	N/A
Estimated amount of GHG emission reductions or GHG removals for this monitoring duration in the registered PDD	50,836 tCO_{2eq}
Certified amount of GHG emission reductions or GHG removals for this monitoring period	34,671tCO_{2e}
Name and UNFCCC reference number of the DOE	Korean Standards Association (KSA) / E-0039
Name, position and signature of the approver of the verification and certification report	JinSeong, Park Director General of Certification Service Division

SECTION A. Executive summary

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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 3rd monitoring period from 01/11/2016 to 03/06/2019.

This verification is based on the draft Monitoring Report (ver.1.0, dated on 21/10/2019), the final Monitoring Report (ver. 2.1, dated on 24/12/2019), 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 01/11/2016 to 03/06/2019, as reported in the Monitoring Report (version 2.1, 24/12/2019) 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 the emission reductions during the monitoring period mentioned above, amount 34,671tons of tCO_2 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 2.0, and employed a risk-based approach, focusing on the identification of significant reporting risks.

As a result of verification activity, KSA confirms that the claimed emission reduction 34,671tCO_2e for 3rd monitoring period (01/11/2016 to 03/06/2019) 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	KyuIl	KSA	V	V	V	V
2.	Verifier	IR	Moon	HyunMan	KSA	V	V	V	V
3	Verifier (Trainee)	OR	Hong	SeungHyeong	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 reports including 1st & 2nd monitoring report - the revised Monitoring plan and its validation opinion 2) personnel experience/ training - Request the senior's review
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

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As per the “para 326 of VVS version 2.0[/13/], 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

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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[/01/] 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, 21/10/2019 and final version 2.1, 24/12/2019) [/01/]
- Emission reductions calculation spreadsheet (initial version 01.0, 21/10/2019 and final version 2.0, 13/12/2019) [/02/]
- Registered PDD (version 10.4) [/03/]
- Validation Report[/04/]
- Revised monitoring plan[/05/] and Validation report of revised monitoring plan[/06/]
- 1st Monitoring Report [/07/] and its Verification Report[/08/]
- 2nd Monitoring Report [/09/] and its Verification Report[/10/]
- Applied monitoring methodology, AMS-III.B version 12.0 [/11/]
- CDM operational Manual for LG Chem Naju plant [/24/]
- Other supplementary documents listed in 'Appendix 3' below

D.2. On-site inspection

Duration of on-site inspection: **04**/12/2019 to 04/12/2019				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	Assess the implementation and operation status	LG Chem Naju Plant	04/12/2019	Sohn, Kyull Moon, HyunMan Hong, SeungHyeong
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 raw data (DCS, PIS) the value reported to the government under K-ETS and so on.			
5.	Check of monitoring equipment including calibration records			
6.	Review the calculation in determining the GHG emission and the emission reductions.			
7.	Identify the QA/QC procedure			

D.3. Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Lee Bae	Hee-Seung Ju-Young	LG Chem (headquarter) LG Chem Naju plant	04/12/2019	- Reviewing of the MR and spreadsheet - Evaluation of materiality - Baseline GHG emissions - Project GHG emissions - Leakage GHG emissions - GHG emission reductions	Sohn, Moon, Hong
2	Bae Lee Yang	Ju-Young Dong-Soo Man-Seung	LG Chem Naju plant (Engineer) LG Chem Naju plant (Analysis laboratory) LG Chem (Calibration)	04/12/2019	- 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, Moon, Hong
3	Yang Jung	Man-Seung Byung-Ryul	LG Chem Naju plant (internal calibration)	04/12/2019	- Internal Calibration for measuring Instruments - Internal Instrument calibration procedure	Sohn, Moon, Hong

D.4. Sampling approach

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Sampling approach is not applied during this verification process.

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	6	0	0

report form			
Compliance of the project implementation and operation with the registered PDD	0	0	0
Post-registration changes	0	0	0
Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines	0		0
Compliance of monitoring activities with the registered monitoring plan	3	6	0
Compliance with the calibration frequency requirements for measuring instruments	1	0	0
Assessment of data and calculation of emission reductions or net removals	1	0	0
Assessment of reported sustainable development co-benefits	0	0	0
Global stakeholder consultation	0	0	0
Others (please specify)	0	0	0
Total	11	6	0

SECTION E. Verification findings

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

Means of verification	Verification team have cross checked all sections of the Monitoring Report/01/ against the latest and valid version of Monitoring report form (CDM-MR-FORM) version 07.0/12/. Each section in the report include proper information that required by relevant guidance. Verification team confirmed the CDM-MR-FORM version 07.0/12/ is correctly modified and applied. The latest instructions for filling out the MR have been followed.
Findings	CL 01, CL02, CL03, CL04, CL05 & CL 06 were raised. Refer to Appendix 4. Based on the review of the revised MR, CL 01, CL02, CL03, CL04, CL05 & CL 06 were appropriate corrected and found satisfied.
Conclusion	Verification team confirms that monitoring report is complied with relevant the latest reporting template CDM-MR-FORM (Version 07.0)/12/ and the instructions for filling out the monitoring report form attached.

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

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Verification team reviewed the previous verification report/10/ and validation report/04/, but no FARs were issued.

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

Means of verification	This 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 inspection to verify implementation and operation against the description in the registered and approved PDD (version 10.4). 1) Relevant date - The starting date of the project activity was 21/06/2006 - Start date of the commercial operation was 20/11/2006. - 1st monitoring period was from 04/06/2009 to 23/02/2011 - This 2nd monitoring period is from 24/02/2011 to 31/10/2016 2) Description of the project activity The fuel-converted project boiler is as follows; - Boiler capacity: 70 T/H

	- Condition of steam produced: 35kg/cm^2.g and 400℃ - Fuel used: Natural gas, purge gas and by-product liquid 3) Operation and maintenance records - O&M Maintenance (Boiler cleaning & Maintenance) /18/ - 70t/h Daily operation records (log-sheet) /17/ 4) Verification Verification team have performed on-site inspection to verify the actual implementation of the PA against the description in the registered PDD (V10.4)/03/ as follows - The project boiler including natural gas burners is in place. - The operation status of the boiler including starting date of the PA and the start date of the commercial operation were checked through the Daily Operation record for 70 ton/h boiler/17/ and the previous MR and its verification report. - The project boiler is properly operating through maintenance of boiler (Annual plant shut down for maintenance/18/) by PP.
Findings	Not applicable. No findings were raised.
Conclusion	Verification team confirms that the project activity has been properly implemented and operated as planned in the registered PDD/03/. - Implementation status is as described in the registered PDD/03/ - Timeline such as starting date of operation listed in the PDD is confirmed - There is no cause of any increase in the actual GHG emission reductions achieved by the registered PDD/03/ in the current monitoring period that was reported in the Monitoring Report/01/.

E.4. Post-registration changes

E.4.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents[1]

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No temporary deviations have been identified for this monitoring period

E.4.2. Corrections

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No corrections have been identified for this monitoring period

E.4.3. Changes to the start date of the crediting period

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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

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

[1] Other standards, methodologies, methodological tools and guidelines (to be) applied in accordance with the applied(selected) methodologies are collectively referred to as the other (applied) methodological regulatory documents).

E.4.5. Permanent changes from registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines or other methodological regulatory documents

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The registered monitoring plan in the PDD was revised and approved by Board on 11/02/2012.
But no permanent changes have been identified for this monitoring period

E.4.6. Changes to the project design

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No changes have been identified for this monitoring period

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

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Not applicable

E.5. Compliance of the registered monitoring plan with applied methodologies, applied standardized baselines, and other applied methodological regulatory documents

Means of verification	Verification team have verified the monitoring plan against the applied methodology AMS-III.B (version 12.0) /11/ to confirm the compliance, then conducted on-site inspection. 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 12.0/11/. 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.
Findings	Not applicable. No findings were raised.
Conclusion	KSA verification team confirms that the monitoring plan is in accordance with the approved monitoring methodology AMS-III.B version 12.0/11/ 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/03/, validation report and applied methodology AMS-III.B version 12.0/11/.

1. Parameter Symbol for data and parameters fixed ex ante

Methodology	Registered PDD	MR	Checked
Fuel use prior to the fuel switch	$FF_{baseline}$	$FF_{baseline}$	OK
	$NCV_{baseline}$	$NCV_{baseline}$	OK
	$EF_{baseline, CO2}$	$EF_{baseline, CO2}$	OK
	$PG_{baseline}$	$PG_{baseline}$	OK
	$NCV_{PG, baseline}$	$NCV_{PG, baseline}$	OK
	$LF_{baseline}$	$LF_{baseline}$	OK
	$NCV_{LF, baseline}$	$NCV_{LF, baseline}$	OK

Output for an appropriate period prior to the fuel switch	$Q_{total, baseline}$	$Q_{total, baseline}$	OK
Natural gas emission factor after fuel switch	$EF_{NG, CO2}$	$EF_{NG, CO2}$	OK

2. Parameter in the monitoring report (MR)

No.	Parameter in the PDD and MR	Description	Assessment
1	$FF_{baseline}$	Quantity of bunker fuel oil C combusted in the baseline situation	As per the registered PDD/03/, 70,730,291liter for $FF_{baseline}$ was appropriately applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
2	$EF_{NG, CO2}$	CO_2 emission factor of the natural gas combusted	As per the registered PDD/03/, 56.1 tCO_2/TJ for $EF_{NG, CO2}$ was appropriately applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
3	$NCV_{baseline}$	Net calorific value of bunker fuel oil C.	As per the registered PDD/03/, 39.1 X 10^{-6} TJ/litre for $NCV_{baseline}$ was appropriately applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
4	$EF_{baseline, CO2}$	CO2 emission factor of bunker fuel oil C	As per the registered PDD/03/, 77.4 tCO_2/TJ for $EF_{baseline, CO2}$ was appropriately applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
5	$Q_{total\ baseline}$	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/03/, 3,701.09 TJ for $Q_{total, baseline}$ was applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
6	$PG_{baseline}$	Quantity of purge gas combusted in the boiler in the baseline situation	As per the registered PDD/03/, 13,203,959 Nm^3 for $PG_{baseline}$ was appropriately applied to the Monitoring Report/01/ and the emission reductions calculation sheet/02/.
7	$LF_{baseline}$	Quantity of by-product liquid fuel combusted in the boiler in the baseline situation	As per the registered PDD/03/, 26,297,017liter for $LF_{baseline}$ was applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.
8	$NCV_{PG, baseline}$	Net calorific value of purge gas	As per the registered PDD/03/, 52.15 X 10^{-6} TJ/Nm^3 for $NCV_{PG, baseline}$ was applied to the Monitoring Report/01/ and the Emission Reductions Calculation sheet/02/.

9	$NCV_{LF, baseline}$	Net calorific value of by- product liquid fuel	As per the registered PDD[/03/], 30.576×10^{-6} TJ/litre for $NCV_{LF, baseline}$ was appropriately applied to the Monitoring Report[/01/] and the Emission Reductions Calculation sheet[/02/].

3. Verification
1) Verification team reviewed the following documents to verify the 'data and parameters fixed ex-ante of crediting period'.
- The registered PDD[/03/].
- Validation Report[/04/]
- Monitoring Report[/01/] and Emission reductions calculation spreadsheet[/02/]
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[/01/] and the Emission Reductions Calculation sheet[/02/].

Findings	Not applicable. No findings were raised.
Conclusion	Verification team confirm that the ex-ante parameters are correctly applied and the value of the ex-ante parameter in the MR is consistent with the same in the registered PDD[/03/], the applied methodology[/11], the validation Report[/04/].

E.6.2. Data and parameters monitored

Means of verification

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 on-site inspection, personnel involved at the appropriate level of operation of project activity have been interviewed.
Verification team have assessed all relevant monitoring parameter as listed in chapter B.7.1 of the revised monitoring plan[/05/] and the registered PDD[/03/] as follows;
1) Appropriateness of the applied measurement/determination method
2) Correctness of the values applied for ER calculation
3) Accuracy and the applied QA/QC measures

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 follow;

1. Parameter Symbol for data and parameters monitored.

Methodology	PDD	MR	Checked
Fuel use after the fuel switch	$FF_{project, y}$	$FF_{project, y}$	OK
	$NCV_{NG, y}$	$NCV_{NG, y}$	OK
	PG_{y}	PG_{y}	OK
	$NCV_{WG, y}$	$NCV_{WG, y}$	OK
	LF_{y}	LF_{y}	OK
	$NCV_{LF, y}$	$NCV_{LF, y}$	OK
Output after the fuel switch	$Q_{total, y}$	$Q_{total, y}$	OK
	$\varepsilon_{project, y}$	$\varepsilon_{project, y}$	OK

2. Parameter in the monitoring report (MR)

No.	Parameter in PDD and MR	Description	Assessment
1.	$FF_{project, y}$	Quantity of natural gas combusted in the project boiler during the year, y	• Measuring/reading/reporting frequency: Quantity of NG consumption is continuously measured by the meter (Tag No. FT-7105 →FT-7705, Refer to CL 09). • Monitoring equipment: The measuring instrument is the meter (Tag No. FT-7705) installed at the boiler inter and the meter is calibrated every 3 years. • 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. • The reported data are cross-checked with the quantity of NG purchased from NG supplier (Haeyang City Gas Co. Ltd.) and the heat balance. And also, it can be cross-checked with the value[/29/] reported to the government after verified by the 3rd party verification body under K-ETS. • 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 3rd party calibration body under ISO 17025 scheme.
2.	PG_y	Quantity of purge gas combusted in the project boiler during year, y	• Measuring/reading/reporting frequency: Quantity of purge gas consumption are continuously measured by the meter (Tag No. FT-7106 →FT-7706, Refer to CL09). • Monitoring equipment: The measuring instrument is the meter (Tag No. FT-7706) installed at the boiler inter and the meter is calibrated every year. • 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. • The reported data are cross-checked with the daily log sheet. And also, it can be cross-checked with the value[/29/] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be compared. 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.

	3.	LF_y	Quantity of by-product liquid fuel combusted in the project boiler during year, y	• Measuring/reading/reporting frequency: Quantity of the by-product liquid fuel consumption are continuously measured by the meter (Tag No. FQ-7104→FQ-7704, Refer to CL 09). • Monitoring equipment: The measuring instrument is the meter (Tag No. FQ-7704) installed at the boiler inter and the meter is calibrated every 3 years. • 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. • The reported values are cross-checked with the daily log sheet. And also, it can be cross-checked with the value[29] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • 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 3rd party calibration body under ISO 17025 scheme.
	4.	$NCV_{NG, y}$	Net calorific value of natural gas	• Measuring/reading/reporting frequency: N/A • $NCV_{NG, y}$ is not measured by the measurement instrument, but determined by "Energy Act"[25] in Korea. • Monitoring equipment: N/A • Data source: "Calorific value table" in "Energy Act"[25] of Korea. • Cross-check: N/A • Data QA/QC $NCV_{NG, y}$ is determined by Energy Act. NCV suitable for period was applied to MR and the emission reduction spread sheet on a daily base.
	5.	$NCV_{WG, y}$	Net calorific value of purge gas	• Measuring/reading/reporting frequency: $NCV_{WG, y}$ is measured by Gas Chromatograph quarterly. The measured value is weighted average considering the purge gas consumed in the project boiler. ※ As per the K-ETS regulation, the weighted average values of the measured value on a weekly basis were applied on a quarterly basis. If there were factors that could affect the increase in the emission reductions, conservative values were applied. (Refer to CAR 03 & CAR 06) • Monitoring equipment: Gas Chromatograph. • Data source: Measured and weighted average.

				• Cross-check: it can be cross-checked with the value[29] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • Data QA/QC $NCV_{WG, y}$ 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,
	6.	$NCV_{LF, y}$	Net calorific value of by-product liquid fuel	• Measuring/reading/reporting frequency: $NCV_{LF, y}$ is measured by 3rd party, KTR that ISO 17025 certified body quarterly. • Monitoring equipment: N/A (measured by 3rd party, KTR) • Data source: Test Report by KTR[31]. • Cross-check: it can be cross-checked with the value[29] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • Data QA/QC tested by the 3rd party, KTR
	7.	$Q_{total, y}$	Total quantity of steam generated by natural gas, purge gas and by-product liquid fuel in the project boiler during year, y	• 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. FT-7102 → FT-7702, Refer to CL 09). • Monitoring equipment: The measuring instrument is the meter (Tag No. FT-7702) installed at the boiler inter and the meter is calibrated every year. • 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. • The reported values are cross-checked with the daily log sheet. And also, it can be cross-checked with the value[29] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • Data QA/QC The measured data are recorded in the PIS and the daily log sheet and can be compared each other. 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.

	8.	$\varepsilon_{project, y}$	Energy efficiency of the boiler during the year, y	• Measuring/reading/reporting frequency: Energy efficiency ($\varepsilon_{project, y}$) is calculated by the direct method (dividing the net heat generation by the energy content of the fuel combusted in the project boiler). • Monitoring equipment: N/A (calculated by the direct method) • Data source: the calculated value using the measured data. • Cross-check: it can be cross-checked with the value[/29/] reported to the government after verified by the 3rd party verification body under Korea emission trading scheme. • Data QA/QC Relevant parameters (steam generation, fuel consumption) are calibrated periodically according to "LG Chem plant CDM Manual" [/24/]. The qualified personnel calculated the energy efficiency of boiler.
Findings	CAR 01, CAR 02, CAR, 03, CAR 04, CAR 05 & CAR 06 and CL 08, CL 09 & CL 10 were raised. Refer to Appendix 4. Based on the review of the revised MR, CAR 01, CAR 02, CAR, 03, CAR 04, CAR 05 & CAR 06 and CL 08, CL 09 & CL 10 were appropriate corrected and found satisfied.			
Conclusion	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[/05/] and the registered PDD[/03/].			

Means of verification	1. $FF_{project, y}$: 1) Description Quantity of natural gas combusted in the project boiler during the year, y 2) Source of data: the measured value on-site 3) Value applied: 41,140,096Nm^3 (1,609.33TJ) 4) Monitoring equipment The meter (Tag No. FT-7705) is used to measure the quantity of NG consumption in the project boiler 5) Calibration frequency: The gas flow meter (Tag No. FT-7705) is calibrated every 3 years and other meters (thermometer and pressure gauge) related to the quantity of NG combusted in the project boiler are also calibrated by every 3 years. 6) Cross-checked with the other available source: • The reported data are cross-checked with the quantity of NG purchased from NG supplier (Haeyang City Gas Co. Ltd.) and the mass/heat balance. • Used LNG were also checked for two other boilers and small emission facilities

	using together on one incoming LNG bill • LG Chemical Naju plant is required to report the emissions to Korean government by emission facility under K-ETS (Korea Emission Trading Scheme). Therefore, the reported data are cross-checked with the values[/29/] which were reported to Korean government under K-ETS. 7) Verification Verification team has assessed the $FF_{project, y}$ (Quantity of natural gas combusted in the project boiler during the year, y) through follows; - The reported data was measured by the calibrated gas flow meter. - The reported data was checked through the PIS and DCS information[/15/] and the daily log sheet[/17/] and compared to the purchase quantity[/30/] provided by NG supplier (Haeyang city gas Co. Ltd.) using the mass balance. - Finally, the reported data have been cross-checked with the value[/29/] reported by the project participant to the government.
Findings	CAR 04 was raised. Refer to Appendix 4. Based on the review of the revised MR, CAR 04 was appropriate corrected and found satisfied.
Conclusion	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[/05/] and the registered PDD[/03/] and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	2. $NCV_{NG, y}$: 1) Description Net calorific value of natural gas in year y 2) Source of data: “Standard Manual for Calorific Value” in “Energy Act” [/25/] of Korean government. 3) Value applied: - 39.4 X 10^{-6} TJ/Nm^3 from 01/11/2016 to 27/12/2017 - 38.9 X 10^{-6} TJ/Nm^3 from 28/12/2017 to 03/06/2019 The energy law revised the NCV for LNG to from 39.4 to 38.9 on 12/28/2017. 4) Monitoring equipment: Not applicable The value is from the “Standard Manual for Calorific Value” in “Energy Act[/25/]” of Korean government. 5) Calibration frequency: Not applicable 6) Cross-checked with the other available source: Not applicable. The value is from the “Standard Manual for Calorific Value in “Energy Act[/25/]” of Korean government. 7) Verification Verification team has assessed the $NCV_{NG, y}$ (Net Calorific value of natural gas in year y) through follows; - The reported data is from the “Calorific Value Table in “Energy Act[/25/]” of

	Korean Government. - The reported data is the same as the weighted average of the changed values during this monitoring period”.
Findings	CAR 01 & CAR 02 were raised. Refer to Appendix 4. Based on the review of the revised MR, CAR 01 & CAR 02 were appropriate corrected and found satisfied.
Conclusion	Verification team confirms that “Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan/05/ and the registered PDD/03/ and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	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 the year y 2) Source of data: The value calculated by considering steam condition after measuring the quantity of steam. 3) Value applied: 2,575.76 TJ $Q_{total, y}$ = (Quantity of generated steam by project boiler) X (Steam enthalpy – feed water enthalpy) Steam heat is calculated by considering daily steam and feed water temperature. Value applied were calculated as below: - Under Quantity of steam generated by project boiler are continuously measured by steam flow meter (FT-7702) and temperature and pressure of steam are also measured by thermometer (TT-7712) and pressure gauge (PT-7701) respectively. - Design condition of steam generated by the project boiler are 27kg/cm^2 and 393℃ and feed water is 110 ~ 145℃ during this monitoring period. But in actual operation steam and feed water condition are fluctuating. Thus, PP calculated the steam heat using daily generated steam, steam pressure and feedwater temperature information. 4) Monitoring equipment The meter (Tag No. FT-7702) 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. 5) Calibration frequency: The gas flow meter (Tag No. FT-7702) is calibrated every year and other meters (thermometer and pressure gauge) related to the quantity of steam generated by project boiler are also calibrated by every year. 6) Cross-checked with the other available source: LG Chemical Naju Plant is required to report the emissions to Korean government by emission facility under KETS(Korea Emission Trading Scheme). Therefore, the reported data are cross-checked with values which were reported to Korean government under K-ETS.

	7) Verification Verification team has assessed the $Q_{total, y}$ (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 and DCS 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.
Findings	CAR 05 was raised. Refer to Appendix 4. Based on the review of the revised MR, CAR 05 was appropriate corrected and found satisfied.
Conclusion	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/05/ and the registered PDD/03/ and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	4. PG_y: 1) Description Quantity of purge gas combusted in the project boiler during the year, y 2) Source of data: the measured value on-site 3) Value applied: 14,095,488Nm^3 (691.854TJ) The above values included the adjusted value due to the delayed calibration for the purge gas flow meter (FT-7706). 4) Monitoring equipment: The meter (Tag No. FT-7706) is used to measure the quantity of purge gas combusted in the project boiler during the year y. 5) Calibration frequency: The g as flow meter (Tag No. FT-7706) is calibrated every year and thermometer (TT-7106) related to the quantity of purge gas combusted in the project boiler are also calibrated by every year. 6) Cross-checked with the other available source: • The reported data are cross-checked with the daily log/15/ & /17/. • LG Chemical Naju Plant is required to report the emissions to Korean government by emission facility under KETS (Korea Emission Trading Scheme). Therefore, the reported data are cross-checked with Korean government reporting information. 7) Verification Verification team has assessed the PG_y (Quantity of purge gas combusted in the project boiler during the year, y) through follows; - The reported data was measured by the calibrated gas 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/29/ by the project participant to the government.

Findings	Not applicable No findings were raised.
Conclusion	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[/05/] and the registered PDD[/03/] and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	5. $NCV_{WG,y}$: 1) Description Net calorific value of purge gas in year y 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. 3) Value applied: 32.98 ~ 55.96 X 10^{-6} TJ/Nm^3 The detailed calculation values refer to the NCV sheet in the Emission Reduction Spreadsheet[/02/]. PP have measured the NCV $_{WG,y}$ 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. 4) Monitoring equipment: Gas chromatograph 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" [/24/] which the followings are specified; - the test and analysis method for NCV - qualification of test/inspection personnel - O&M for test equipment - Certificate of used standard material (gas). 6) Cross-checked with other available source: the reported values are cross-checked with the value[/26/ & /27/] verified by the 3rd party verification body and approved by the Korean government as per K-ETS. 7) Verification - Verification team checked the K-ETS regulation[/26/ & /27/] (Guideline for greenhouse gas and energy target management scheme) and Guideline for development of emission factor. - Verification team checked the test method, test procedure, qualification of tester, test instruments which are specified in the "CDM operation manual"[/24/] and also checked the related documents such as contract of GC maintenance, reference material (standard gas). - The test was carried out quarterly during this monitoring period and PP calculated the values by weighted average. - Finally, verification team cross-checked the values with the value reported by the project participant to the government.

Findings	CL 10 was raised. Refer to Appendix 4. Based on the review of the revised MR, CL 10 was appropriate corrected and found satisfied.
Conclusion	Verification team confirms that "Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan/05/ and the registered PDD/03/ and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	6. LF_y: 1) Description Quantity of by-product liquid fuel combusted in the project boiler during the year, y 2) Source of data: measured on-site and transmitted into PIS and DCS archived. 3) Value applied: 22,020,332 litres (652.967TJ) 4) Monitoring equipment The meter (Tag No. FQ-7704) is used to measure the quantity of by-product liquid combusted in the project boiler during the year y. 5) Calibration frequency: The gas flow meter (Tag No. FQ-7704) is calibrated every 3 years. 6) Cross-checked with the other available source: • The reported data are cross-checked with the daily log. • LG Chemical Naju Plant is required to report the emissions to Korean government by emission facility under KETS (Korea Emission Trading Scheme). Therefore, the reported data are cross-checked with Korean government reporting information. 7) Verification Verification team has assessed the LF_y (Quantity of by-product liquid fuel combusted in the project boiler during the year, y) 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.
Findings	Not applicable No findings were raised.
Conclusion	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/05/ and the registered PDD/03/ and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	7. $NCV_{LF, y}$: 1) Description Net calorific value of by-product liquid fuel 2) Source of data: weighted average value[/31/] using data measured by the 3rd party body, KTR (Korea Testing and Research Institute accredited by KOLAS). 3) Value applied: 27.68 ~ 31.20 X 10^{-6} TJ/litre[/31/] The detailed calculation value refers to the NCV sheet in the Emission Reduction Spreadsheet. $NCV_{LF, y}$ was measured by 3rd party body quarterly and were weighted averages. And the results are appropriately applied to the emission calculation ER calculation sheet. 4) Monitoring equipment: Not applicable $NCV_{LF, y}$ was measured by 3rd party body, KTR accredited by KOLAS as per ISO 17025) 5) Calibration frequency: Not applicable $NCV_{LF, y}$ was measured by 3rd party body, KTR accredited by KOLAS as per ISO 17025) 6) Cross-checked with the other available source: the reported values are cross-checked with the value verified by the 3rd party verification body and approved by the Korean government as per K-ETS. 7) Verification - Verification team checked the test report tested by KTR. - The test was carried out every quarter during this monitoring period and PP calculated the values by weighted average. - Finally, verification team cross-checked the values with the value reported by the project participant to the government.
Findings	Not applicable. No findings were raised.
Conclusion	Verification team confirms that Net calorific value of natural gas in year y are appropriately managed as described in the revised monitoring plan[/05/] and the registered PDD[/03/] and the value are appropriately applied to the MR and the emission reductions spread sheet.

Means of verification	8. $\varepsilon_{project, y}$: 1) Description Energy efficiency of the boiler during the year, y 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) 3) Value applied: 87.2% Boiler efficiency is the weighted average for each period.

	4) Monitoring equipment: Not available. 5) Calibration frequency: Not available. 6) Cross-checked with the 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. 7) Verification Verification team assessed the $\varepsilon_{project, y}$ (Energy efficiency of the project boiler during the year, y) as follows; - 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. - 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. - Finally, verification team checked the calculation process of energy efficiency in the project boiler during the year.
Findings	CAR 03 was raised. Refer to Appendix 4. Based on the review of the revised MR, CL 10 was appropriate corrected and found satisfied.
Conclusion	Verification team confirms that the energy efficiency of boiler during the year, y ($\varepsilon_{project, y}$) are appropriately managed as described in the revised monitoring plan[/05/] and the registered PDD[/03]

E.6.3. Implementation of sampling plan

Means of verification	N/A
Findings	N/A
Conclusion	Sampling plan is not developed in the revised monitoring plan and the registered PDD[/03/].

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 (1st and 2nd) monitoring report[/07 /& /09/] and the previous (1st and 2nd) verification report[/08/ /10/] - Registered PDD[/03/] - Validation Report[/04/] - Revised monitoring plan[/05/] - Validation report of revised monitoring plan[/06/] - Approved methodology AMS-III.B. [/11/] - CDM Operation Manual for LG Chem Naju Plant. [/24/] The parameters monitored to calculate the emission reduction during the monitoring period are as follows; **1. $FF_{project, y}$:** 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	FT-7705 / 15-S0728HN	
Calibration entity	3rd Party Calibration body	
Calibration frequency	Every 3 years	
Previous calibration (Cert. No.)	04/11/2013 (OKA13-11-213) (Uncertainty: 0.42%)	OK
Latest calibration (Cert. No.)	30/10/2017 (17-K10-0652) (Uncertainty: 0.61%)	NG
Applied period of max. permissible errors where applicable	04/11/2016 to 29/10/2017	

- The gas flow meter (FT-7705) was calibrated by the 3rd party calibration laboratory (Woojin) under KOLAS (Kora Laboratory Accreditation Scheme) on 30/10/2017 exceeding validity.
- Calibration for LNG flowmeter (FT-7705) were delayed from 04/11/2016 to 29/10/2017 during the monitoring period. The error is smaller than the maximum permissible. So, the conservative value of LNG flow was applied the maximum permissible error of LNG flowmeter from 04/11/2016 to 29/10/2017. The variation in emission reductions due to the delayed meter calibration (from 04/11/2017 to 29/29/2017) are decreased approximately 130tCO_{2e}.

3) Verification

- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan/05/ and related validation report/06/, 1st and 2nd monitoring report/07/ & /09/ and 1st and 2nd verification report/08/ & /10/, and the registered PDD/03/ and Validation report/04/)
- 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" /25/ 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:

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	FT-7702 /91M642405	
Calibration entity	Internal Calibration	
Calibration frequency	Every 1 year	
Previous calibration	16/04/2016 (0.0%)	
	30/10/2017 (0.02%)	NG
	27/03/2018 (4.50%)	OK
Latest calibration	10/04/2019 (0.05%)	NG
Applied period of max. permissible errors where applicable	16/04/2017 to 29/10/2017 27/03/2019 to 09/04/2019	

- The previous calibration was calibrated as above table.
- The latest calibration date: 10/04/2019.
- On 27/03/2018, the calibration results exceeded the max. permissible error, but the emission reductions were not adjusted because it was carried out within the calibration frequency and corrected.
- The steam flow meter (FT-7702) was calibrated by the internal using the calibration standard instrument (Digital multi-meter, S/N: 6210191)/21/ that has calibrated regularly by 3rd party calibration body.
- The variation in emission reductions due to the delayed meter calibration (from 16/04/2017 to 29/10/2017 and 27/03/2019 to 09/04/2019) are decreased approximately 470tCO_{2e} and 29 tCO_{2e} respectively.

3) Verification

- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan and related validation report, 1st and 2nd monitoring report and 1st and 2nd 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/23/.

4. PG_y

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

2) Monitoring equipment and calibration information

Subjects	Contents	Remarks
Type	Differential pressure flow meter	
Manufacturer	FUJI	
Model Type	EJA110A Style S1	

Accuracy	±2.0% Full scale	
Tag No./SN	FT-7706 /91L751790	
Calibration entity	Internal Calibration	
Calibration frequency	Every 1 year	
Previous calibration	16/04/2016	OK
	30/10/2017	NG
	27/03/2018	OK
Latest calibration	10/04/2019	NG
Applied period of max. permissible errors where applicable	From 16/04/2017 to 29/10/2017 From 27/03/2019 to 09/04/2019	

• The previous calibration was calibrated as above table.
• The latest calibration date: 10/04/2019.
• The flow (FT-7706) was calibrated by the internal using the calibration standard instrument (Digital multi-meter, S/N: 6210191)/23/ that has calibrated regularly by 3rd party calibration body.
• The variation in emission reductions due to the delayed meter calibration (from 16/04/2017 to 29/10/2017 and 27/03/2019 to 09/04/2019) are decreased approximately 105tCO_{2e} and 5 tCO_{2e} respectively.

3) Verification
- Verification team checked the calibration period of meter through the review of documentation (Revised monitoring plan and related validation report, 1st and 2nd monitoring report and 1st and 2nd 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/20/.

5. NCV $_{PG, y}$:

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 $_y$

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	±0.5%	

Tag No./SN	FQ_7104 / CN25-8674R	
Calibration entity	3rd party calibration	
Calibration frequency	Every 3 year	
Previous calibration	22/10/2014 (FTL14-10-576)	OK
Latest calibration (Cert. No.)	31/07/2017	OK
Applied period of max. permissible errors where applicable	N/A	

- The LF flow meter (FQ-7704) was calibrated by the 3rd party, FLOTRO which accredited by ISO 17025 and was replaced to ALTI mass Type U (S/N: CN25-8674R) on 31/07 2017 within validity.
- The previous calibration date: 22/10/2014: verified during 2nd monitoring period (refer to the 2nd Verification Report)
- The applied period of max. permissible error when applicable: N/A

7. $NCV_{LF, y}$

1) Description: Net calorific value of by-product liquid fuel

2) Monitoring equipment and calibration information: N/A
$NCV_{LF, y}$ is measured by 3rd Party under KOLAS quarterly.

8. $\varepsilon_{project, y}$

1) Description: Energy efficiency of boiler during the year y

2) Monitoring equipment and calibration information: N/A
$\varepsilon_{project, y}$ is calculated by the direct method (dividing the net heat generation by the energy content of the fuel combusted.

Findings	CL 07 was raised. Refer to Appendix 4. Based on the review of the revised MR, CL 07 was appropriate corrected and found satisfied.
Conclusion	Verification team confirms followings - The calibration frequency for measuring instrument are appropriately manged as described in the revised monitoring plan/05/ and the registered PDD/03/. - 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/05/. 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 ($FF_{project,y}$): 41,140,096 Nm^3 (1,609,33GJ)
- Purge gas (PG_y): 14,095,488 Nm^3 (691,854GJ)
- by-product liquid (LF_y): 22,020,332liter (652,967GJ)

② NCV of each fuel
- Natural gas ($NCV_{NG,y}$): 39.4 X 10^{-6} TJ/Nm^3 and 38.9 X 10^{-6} TJ/Nm^3
- Purge gas ($NCV_{WG,y}$): 32.98 ~ 55.96 X 10^{-6} TJ/Nm^3
- By-product liquid ($NCV_{LF,y}$): 27.68 ~ 31.20 X 10^{-6} TJ/Nm^3

③ Heat production ($Q_{total,y}$): 2,575.76TJ

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

$BE_y = EF_{baseline} \times Q_y$

$= 89.05\ tCO_2/TJ \times 1{,}403.20TJ = 124{,}954.58\ tCO_{2e}$

$EF_{baseline}$: 89.05 tCO_{2eq}/TJ (as per the registered PDD)

The heat amount of steam generated by NG in fuels (LN, purge gas and by-product liquid fuel) are calculated as follows.

$$Q_y = Q_{total,y} \times \frac{FF_{project,y} \times NCV_{Ng,y}}{FF_{project,y} \times NCV_{NG,y} + PG_y \times NCV_{WG,y} + LF_y \times NCV_{LF}}$$

$$= 2{,}575.76 \times \frac{1{,}609.33}{1{,}609.33 + 652.967 + 691.854}$$

$$= 1{,}403.20$$

During the verification the calculation of baseline has been checked. In detail the following has been verified:

- Transparency: it has been checked whether the calculation of baseline emission is fully traceable and where used, the emission reduction spread sheet calculation[/02/] provides all calculation formulae.
- Parameter consistency: It has been checked whether all internal and external parameters and data used for the calculation are applied.
- 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[/03/] and the applied methodology, AMS-III.B (ver.12) [/11/].
- Completeness: it has been checked whether all calculations are complete and without omissions.

The following sources of information has been used in this section.

- Monitoring Report[/01/]
- The revised monitoring plan[/05/]
- Validation report of the revised monitoring plan[/02/]
- Registered PDD[/03/]
- Validation Report[/04/]
- Emission reduction spread spreadsheet[/02/]
- AMS-III.B version 12.0[/11/]

Findings	Not applicable No findings were raised.
Conclusion	Verification team confirms that baseline emissions is appropriately calculated to be 124,954.58 tCO_{2e} as per the formulae and methods described in the revised monitoring plan and the registered PDD[/03/] and the applied methodology[/11/].

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

Means of verification	The key parameters to calculate the project emissions are as below; ① After the fuel switch, NG combusted in the project boiler during the year, y is 41,140,096Nm^3 (1,609.33TJ) during the monitoring period ② NCV of natural gas ($NCV_{NG,y}$): 39.4 and 38.9 × 10^{-6} TJ/ Nm^3 ③ $EF_{NG,CO2}$: 56.1 tCO2/TJ (As per the registered PDD) After the fuel switch, the project emissions are calculated as below; $PE_y = FF_{project,y} \times NCV_{NG,y} \times EF_{NG,CO2}$ = 1,609.33TJ X 56.1tCO_2/TJ = 90,283.43 tCO_{2e} The following sources of information has been used in this section. • Monitoring Report[/01/] • The revised monitoring plan[/05/] • Validation report of the revised monitoring plan[/02/] • Registered PDD[/03/] • Validation Report[/04/] • Emission reduction spread spreadsheet[/02/] • AMS-III.B version 12.0[/11/]
Findings	Not applicable No findings were raised.
Conclusion	Verification team confirms that the project emissions are appropriately calculated to be 90,283.43 tCO_{2e} as per the revised monitoring plan and registered PDD[/03/] and the applied methodology[/11/].

E.8.3. Calculation of leakage GHG emissions

Means of verification	According to the AMS-III.B version 12 and registered PDD, validation report and the previous monitoring report & verification report, no leakage emission (LE_y) is needed to be considered. Therefore, LE y = 0 tCO2eq
Findings	Not applicable No findings were raised.
Conclusion	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

Means of verification	The verification team have cross-checked the GHG emission reductions calculation in the Monitoring report[/01/] against the ER calculation spreadsheet[/02/] and, the revised monitoring plan[/05/] and the registered PDD[/03/]. According to the applied methodology AMS-III.B version 12[/11/], the revised monitoring plan and the registered PDD[/03/], the emission reductions resulting from the project activity are calculated based on the following formula. $ER_y = BE_y - PE_y - LE_y$ = 124,954.58tCO_{2e} – 90,283.43 tCO_{2e} – 0 tCO_{2e} = 34,671.15 tCO_{2e} ≒34,671 tCO_2

Where ER_y : Emission Reductions in year y tCO_2
BE_y : Baseline Emissions in year y tCO_2
PE_y : Project Emissions in year y tCO_2
LE_y : Leakage Emissions in year y tCO_2

The emission reductions during this monitoring period (01/11/2016 to 03/06/2019) are calculated to be 34,671 tCO_2 as follows;

Subjects	Monitoring Periods (01/11/2016 to 03/06/2019)	Remarks
Baseline emissions	124,954.58tCO_{2e}	
Project emissions	90,283.43 tCO_{2e}	
Leakage	0 tCO_2	
Emission Reductions	34,671 tCO_{2e}	

Findings

Not applicable
No findings were raised.

Conclusion

KSA confirms that:

- All data and parameters were monitored in accordance with the revised monitoring plan and the registered PDD[/03/];
- Monitoring data are verified and cross-checked;
- Complete set of data have been correctly applied to emission reduction calculation;
- Calculation of baseline, project, and leakage emission have been performed in accordance with the formula and methods described in the revised monitoring plan[/05/] and the registered PDD[/03/] and the applied methodology[/11/]; and,

All assumptions, emission factors and default values applied to the calculation are appropriate.

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[/05/] and the registered PDD[/03/] and converted the estimated reductions to annual corresponding monitoring period.
Claimed emission reduction for this monitoring period 34,671 tCO_2e which is much less than the estimated values in the revised monitoring plan[/05/] and the registered PDD.

Subjects	Emission Reductions (ERs)	Remarks
Expected ERs	50,836 tCO_{2eq}	19,635tCO_{2eq}/year X 945/365 year = 50,836 tCO_{2eq}
Actual ERs	34,671 tCO_{2eq}	34,671 X (365/945) = 13,391.44 tCO_{2eq} / year

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.
- Consumption ratio of NG ($FF_{project, y}$) were decreased.
- Annual Steam generation (Q_y) from the project boiler were decreased.
- During this monitoring period, downtime due to maintenance was increased. Downtime was 116 days during this monitoring period.

Findings	CL 11 was raised. Refer to Appendix 4. Based on the review of the revised MR, CL 11 was appropriate corrected and found satisfied.
Conclusion	Emission reductions for this monitoring period is deceased by 32% compared to the revised monitoring plan[/05/] and the registered PDD[/03/]. But verification team confirms that the actual of emission reductions of 34,671tCO_2 during this monitoring period are deemed reasonable

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

Means of verification	To identify the difference from estimated value in the registered PDD, verification team have checked the following documents - the revised approved PDD - the previous MR and the verification report - Monitoring Report including the parameters - emission reduction calculation spreadsheet The reason for the decrease in emission reduction during the corresponding monitoring period is that the consumption ratio of NG ($FF_{project, y}$), Annual steam generation (Q_y) and downtime period were changed compared to the ex-ante estimate at the registered PDD[/03/].
Findings	N/A No findings were raised.
Conclusion	Even though the emission reductions for this monitoring period is deceased by 32% compared to the registered PDD[/03/], verification team confirms that the actual of emission reductions of 34,671tCO_2 are deemed reasonable. Therefore, verification team confirms that the fluctuations in emission reduction are not caused to any errors, misstatement, or omissions.

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

Means of verification	The emission reductions before 01/01/2013 and from 01/01/2013 during this monitoring period are as follows; - Amount achieved before 01/01/2013: 0 tCO_{2e} - Amount achieved from 01/01/2013: 34,671 tCO_{2e} - Total emission reduction 34,671 tCO_{2e} To confirm the emission reduction by period, verification team have checked the followings; - NG consumption from the project boiler by period - Steam generation from the project boiler by period. - Calculation process in spread sheet
Findings	N/A No findings were raised.
Conclusion	The actual monitoring period does not fall into the first commitment period.

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

Means of verification	Not applicable
Findings	Not applicable
Conclusion	Not applicable

E.10. Global stakeholder consultation

Means of verification	Not applicable
Findings	Not applicable
Conclusion	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 01/11/2016 to 03/06/2019, 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 are 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/03/.
- 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/05/ and the registered PDD.
- The monitoring plan in the revised monitoring plan/05/ and the registered PDD/03/ is as per the applied baseline and monitoring methodology.

In KSA's opinion, the project's reported GHG emission reductions for the period from 01/11/2016 to 03/06/2019, as reported in the Monitoring Report version 2.1 dated 24/12/2019 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 3rd monitoring period from 01/11/2016 to 03/06/2019.

The verification consisted of the following three phases;

i) desk review of the revised monitoring plan[/05/] 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 21/10/2019, the final monitoring report (version 2.1) dated 24/12/2019, 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 34,671t$CO_{2e.}$

Appendix 1. Abbreviations

Abbreviations	Full texts
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CL	Clarification Request
CO_2	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. Moon, HyunMan	Mr. Hong, SeungHyeong	Mr. Choi, SeungKeun
Role	Verification team leader	Verifier	Verifier (Trainee)	Technical Reviewer
Competence in relevant sector	Competence sector 1(T.A. 1.1)	-	-	Competent in sector 1(T.A. 1.1)
Responsibility	Document review, Interview, Findings & resolution, VR preparation	Document review, Interview, Findings & resolution,	Document review, Interview, Findings & resolution,	Technical Review

KSA

CDM 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	VALID UNTIL
2019.04.04	2022.04.03

PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

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

KSA-BF-506(Rev.2, '09.12.05) 1/1

KSA

CDM Validator/Verifier Certificate

HyunMan Moon

Certificate No. : CDM-030

Technical Area : 1.2, 3.1

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	VALID UNTIL
2019.05.01	2021.04.30

PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

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

KSA-QEF-506(Rev.1, '09.01.05) 1/1

KSA

CDM Validator/Verifier Certificate

SeungHyeong Hong

Certificate No. : CDM-032

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	VALID UNTIL
2019.05.01	2021.04.30

PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

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

KSA-QEF-506(Rev.1, '09.01.05) 1/1

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	VALID UNTIL
2019.04.04	2022.04.03

PRESIDENT OF KSA

KOREAN STANDARDS ASSOCIATION

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

KSA-BF-506(Rev.2, '09.12.05) 1/1

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, 21/10/2019 - final version 2.1, 24/12/2019	/01/	PP
2	PP	Emission reductions calculation spreadsheet - initial version 1.0, 21/10/2019 - final version 2.0, 13/12/2019	/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	1st Monitoring Report	/07/	Others
8	KFQ	1st Verification Report	/08/	Others
9	PP	2nd Monitoring Report	/09/	
10	KSA	2nd Verification Report	/10/	
11	CDM EB	AMS-III.B. (version 12.0)	/11/	Others
12	CDM EB	Monitoring report form (CDM-MR-FORM)	/12/	Others
13	CDM EB	CDM Validation and Verification standard for project activities. (version 2.0)	/13/	Others
14	CDM EB	Guideline on the application of materiality in verifications. (version 2.0)	/14/	Others
15	PP	Raw data from PIS and DCS data (daily) - Steam generated by the project boiler - Consumption of NG. - Consumption of Purge gas - Consumption of by-product liquid fuel	/15/	PP
16	PP	Inventory for LG Chem Naju plant under K-ETS. - FY 2016 - FY 2017 - FY 2018	/16/	PP
17	PP	Daily operation record for 70 ton/h boiler	/17/	PP
18	PP	Annual plant Shut down for maintenance.	/18/	PP
19	Flotron Woojin	Calibration certificate for natural gas flow meter - dated 04/11/2013 by Flotron under KOLAS (ISO 17025) (0.42%) - dated 30/10/2017 by Woojin under KOLAS (ISO 17025) (0.62%)	/19/	PP
20	PP	Calibration certificate for purge gas flow meter - Dated 16/04/2016 (internal calibration) - Dated 30/10/2017 (internal calibration) - Dated 27/03/2018 (internal calibration) - Dated 10/04/2019 (internal calibration)	/20/	PP
21	Flotron OVAL cooperation	Calibration certificate for by-product liquid fuel flow meter. - Dated 22/10/2014 by Flotron under KOLAS (ISO 17025 - Dated 31/07/2017 by OVAL cooperation (replaced with new flow meter)	/21/	PP
22	PP	Calibration certificate for steam flow meter - Dated 16/04/2016 (internal calibration) - Dated 30/10/2017 (internal calibration) - Dated 27/03/2018 (internal calibration) - Dated 10/04/2019 (internal calibration)	/22/	PP
23	Korea Research Centre for	Standard equipment specification (Digital Multi-meter, S/N: 6210191) used for internal calibration - dated 27/05/2016) by KRC under KOLAS (ISO	/23/	PP

	Measuring instruments Co., Ltd.	17025) - dated 22/04/2017 by KRC under KOLAS (ISO 17025) - dated 19/04/2018 by KRC under KOLAS (ISO 17025) - dated 18/03/2019 by KRC under KOLAS (ISO 17025)		
24	PP	CDM Operation Manual for LG Chem Naju plant	/24/	PP
25	Government of Korea	Energy Act	/25/	Others
26	Government of Korea	Guideline for development of heat factor and emission factor.	/26/	Others
27	Government of Korea	Guideline for Korea's emission trading scheme.	/27/	Others
28	PP	PG gas fuelization project report	/28/	PP
29	PP	Inventory Report for Naju plant under K-ETS (from 2016 to 2018)	/29/	PP
30	Haeyang City gas	Monthly Bill of LNG by Haeyang city gas	/30/	PP
31	KTR	Test Report for LF by KTR	/31/	PP
32	PP	Name tag information for measuring equipment	/32/	PP

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

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

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

Table 2. CL from this verification

CL ID	CL01	**Section no.**	E.1	**Date:** 04/12/2019
Description of CL				
Some items in the cover page of the MR do not follow the instructions. ex) the applied methodology and the sector scope				
Project participant response				**Date:** 13/12/2019
The applied methodology and the sector scope are described in the correct row.				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP correctly revised the Sectoral scopes and applied methodology in cover of MR. Thus, CL01 was checked and satisfied. CL 01 is closed.				
CL ID	CL02	**Section no.**	E.1	**Date:** 04/12/2019

Description of CL				
PP have not provided the purpose of the project activity at section A.1.				
Project participant response				**Date:** 13/12/2019
The purpose of the project activity is described in Section A.1 - The Project activity aims at reducing GHG emissions through fuel switching, from bunker fuel oil C to natural gas, in existing LG Chem's Naju plant				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP provided the purpose of the project activity at section A.1 in accordance with the instruction for completing MR form. Thus, CL02 was checked and satisfied. CL 02 is closed.				
CL ID	CL03	**Section no.**	E.1	**Date:** 04/12/2019
Description of CL				
PP have not correctly proved the duration at section A.5.				
Project participant response				**Date:** 13/12/2019
The duration is changed correctly in A.5. - The Duration: 04/06/2009 ~ 03/06/2019				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP revised the crediting period and duration at section A.5 in accordance with the instruction for completing MR form. Thus, CL03 was checked and satisfied. CL 03 is closed.				
CL ID	CL04	**Section no.**	E.1	**Date:** 04/12/2019
Description of CL				
There are 3 parts such as section (b) (c) and (d), but no part section (a).				
Project participant response				**Date:** 13/12/2019
The part section (a) is specified. And the information of monitoring period is moved to part section(b).				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP lists the subsection at section B.1 such as (a), (b) & (c) instead of (b), (c) & (d) Thus, CL04 was checked and satisfied. CL04 is closed.				
CL ID	CL05	**Section no.**	E.1	**Date:** 04/12/2019
Description of CL				
The date type is described with DD/MM/YY instead of DD/MM/YYYY and No. 11 to 15 information in [table 4] are not correct. Please check the date type throughout the MR.				
Project participant response				**Date:** 13/12/2019
The date type is changed throughout MR. And typo in table 4 is changed correctly.				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP correctly revised the date type throughout the MR. Thus, CL05 was checked and satisfied. CL05 is closed.				
CL ID	CL06	**Section no.**	E.1	**Date:** 04/12/2019
Description of CL				
PP not correctly described the row "purpose of data/parameter" at section D.				
Project participant response				**Date:** 13/12/2019
Purpose of data' is changed to 'purpose of data/parameter' according to the MR form and the contents of table in D.1. and D.2 is changed to 'the calculations of Baseline emission'.				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP correctly revised the purpose of data/parameter in Table of section D.1 and D.2. So, Monitoring report is appropriately revised. Thus, CL06 was checked and satisfied. CL06 is closed.				
CL ID	CL07	**Section no.**	E.7	**Date:** 04/12/2019
Description of CL				

PP not provided date of last calibration and validity for the row “Monitoring equipment”.

Project participant response | **Date:** 13/12/2019

The last calibration and validity are specified in D.2.

Documentation provided by project participant

- Revised Monitoring Report

DOE assessment | **Date:** 19/12/2019

PP provided the information for the last calibration and validity in the “Table for monitoring equipment” at section D.2. PP revised appropriately the Monitoring Report.
Thus, CL07 was checked and satisfied. CL07 is closed.

CL ID	CL08	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CL

PP is required to demonstrate that the submitted inventory report under K-ETS is the latest version for FY 2016 to 2018. During on-site verification, the verification team will verify the inventory report under K-ETS to verify the project activity boiler, so please prepare to verify whether it was revised or not.

Project participant response | **Date:** 13/12/2019

The latest version for FY 2016 to 2018 was sent to VT at the on-site verification.

Documentation provided by project participant

- Inventory Report for LG Chem Naju for FY 2016 to 2018 plant under K-ETS.

DOE assessment | **Date:** 19/12/2019

The verification team checked the inventory of LG Chem’s Naju plant from 2016 to 2018 under K-ETS directly from the http://ngms.go.kr during on-site inspection.
Verification team cross-checked the emission reductions for this project activity using those inventory information. Thus, CL08 was checked and satisfied. CL08 is closed.

CL ID	CL09	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CL

PP is required to submit the evidence for name tag change information including when and how ($FF_{project,my}$).

Project participant response | **Date:** 13/12/2019

The DCS was installed in 10/11/2017. it could be checked by the DCS data that sent to VT at the on-site verification. The name tag was changed before installation of the DCS. Please check the attached picture that descried old and new name tag. And the old and new name tag is specified in the MR in D.2.

	New	Old
LNG flow meter	FT-7705	FT-7105
LNG thermometer	TT-7705	TT-7105
PG flow meter	FT-7706	FT-7106
PG thermometer	TT-7106	TT-7706
LF flow meter	FQ-7704	FQ-7104
Steam flow meter	FT-7702	FT-7102
Steam thermometer	TT-7712	TT-7112
Steam pressure gauge	PT-7701	PT-7101

Documentation provided by project participant

- Revised Monitoring Report
- Photos for Measuring instruments including old and new name tag[/32/.]
- List of measuring instruments

DOE assessment | **Date:** 19/12/2019

PP provided a list of measuring instruments and a photograph of measuring instruments with new and old tag names to confirm the change in tag name of the measuring instruments.
Verification team can check the change of the name tag of the measuring device through the above information. Also, verification team checked the new and old name tag on each measuring instruments during the on-site inspection.
In addition, the DCS data provided by PP was found to be suitable through the short heat balance (generated steam and used fuel). Thus, CL09 was checked and satisfied. CL09 is closed.

CL ID	CL10	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CL

Please explain the reason for variation in NCV for purge gas by quarter of the monitoring period. (Section D.2)

Project participant response | **Date:** 13/12/2019

The PG is produced in various octanol processes with different operating conditions and compositions. The NCV for PG is changed by operating conditions and compositions in various octanol. it is specified in D.2.				
Documentation provided by project participant				
- N/A				
DOE assessment				**Date:** 19/12/2019
PP explained the reason for variations in NCV for purge gas by quarter of the monitoring period. If the NCV of the PG is high, then the emission is reducing. Thus, if the heat balance (using the generated steam and used fuels) is unique, then PP was conservatively calculated by applying high NCV of PG. Refer CAR 03. Thus, CL10 was checked and satisfied. CL10 is closed.				
CL ID	CL11	**Section no.**	E.8.5	**Date:** 04/12/2019
Description of CL				
When demonstrating a small project activity, PP described that the emission reductions for the monitoring period is indicated rather than annual. Please refer to the section E.7 of Monitoring Report.				
Project participant response				**Date:** 13/12/2019
The annual emission reduction was described in E.7.				
Documentation provided by project participant				
- Revised Monitoring Report				
DOE assessment				**Date:** 19/12/2019
PP indicated the annual emission reductions at section E.7. of Monitoring Report. Annual emission reductions were calculated as 34,671 tCO2e /(945days X 365days/year) = 13,389tCO_{2e}/year. Thus, the project activity not exceeds the limit of the small-scale project activity. Thus, CL11 was checked and satisfied. CL11 is closed.				

Table 3. CAR from this verification

CAR ID	CAR 01	**Section no.**	E.6.2	**Date:** 04/12/2019
Description of CAR				
The NCVs of the energy law has been in effect since 28/12/2017, but PP was calculated as 31/12/2017 without considering it.				
Project participant response				**Date:** 13/12/2019
PP is applied by modifying the NCV of LNG as follows. - 39.4MJ/N㎥(by 27/12/2017) - 38.9MJ/N㎥(after 28/12/2017)				
Documentation provided by project participant				
- Revised Monitoring Report *- Emission Reductions spreadsheet for LG Chem Naju plant.*				
DOE assessment				**Date:** 19/12/2019
PP correctly applied NCV 38.39MJ/N㎥ instead of 39.4 MJ/N㎥ from 28/12/2017 to 31/12/2017. The related emission reductions result in increase of 1.94tCO_{2e}. Thus, CAR 01 was checked and satisfied. CAR 01 is closed.				
CAR ID	CAR 02	**Section no.**	E.6.2	**Date:** 04/12/2019
Description of CAR				
PP calculated the emission reduction applying the conservative approach for the delayed calibration period for LNG flow meter using the weighted average value including the NCV not the delayed period.				
Project participant response				**Date:** 13/12/2019
The weighted average value was changed using the raw data for LNG, PG and LF. The emission reductions were changed from NCV for PG and LNG was reduced 10tCO_2.				
Documentation provided by project participant				
- Revised Monitoring Report *- Emission Reductions spreadsheet for LG Chem Naju plant.*				
DOE assessment				**Date:** 19/12/2019
PP applied with an appropriate NCV value for LNG at the time other than the weighted average value. PP correctly revised the emission reductions. The related emission reductions result in decrease about 10tCO_{2e}. Thus, CAR 02 was checked and satisfied. CAR 02 is closed.				
CAR ID	CAR 03	**Section no.**	E.6.2	**Date:** 04/12/2019
Description of CAR				

Name plate specified that the efficiency of the project boiler is 91%, but for some periods, the efficiency is excessively high considering the steam generated and the fuel consumed. Specially, the following periods are very high. PP is required to a reasonable explanation including the adequacy of the data such as steam generated and fuels consumed.

Project participant response	**Date:** 13/12/2019

As explained in CL10, the NCV for PG is changed by operating conditions. Based on the NCV analysis results, abnormal data were confirmed by applying different NCV.
Several periods of data showed unexplained boiler efficiency due to system errors, and data for that period was deleted in the MR sheet as the conservative approach. The periods of data specified in the MR sheet. So, the emission reduction was reduced.

Documentation provided by project participant

- *Revised Monitoring Report*
- *Emission Reductions spreadsheet for LG Chem Naju plant.*

DOE assessment	**Date:** 19/12/2019

Abnormal data are due to NCV variation in purge gas, and PP conservatively calculated the emission reductions by applying high NCV value of purge gas.
The emission reductions resulting CAR 03 & CAR 06 result in about 856tCO_{2e} decrease.
Thus, CAR 03 was checked and satisfied. CAR 03 is closed.

CAR ID	CAR 04	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CAR

There are no steam generation, but there is some LNG consumption. (refer 05/11/2017)

Project participant response	**Date:** 13/12/2019

The steam generated by the boiler was vented due to the test of DCS. Thus, the steam was not measured. All data in 05/11/2017 is deleted in the MR sheet. As CAR04, the emission reduction was increased about 9CO_{2e}.

Documentation provided by project participant

- *Revised Monitoring Report*
- *Emission Reductions spreadsheet for LG Chem Naju plant.*

DOE assessment	**Date:** 19/12/2019

PP excluded LNG consumption for testing purposes that did not produce steam from emission reductions. It is reasonable to exclude LNG used without steam production because it has no effect on actual emission reductions. The emission reductions resulting CAR 04 result in about 9tCO_{2e} increase.
Thus, CAR 04 was checked and satisfied. CAR 04 is closed.

CAR ID	CAR 05	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CAR

The steam generated by the project boiler in February 2017 on the emission reductions spreadsheet submitted by PP differs from the steam generated during the on-site inspection.
- spreadsheet: 22,671 ton
- PIS & DCS: 23,825 ton

Project participant response	**Date:** 13/12/2019

The steam generated by the project boiler in February 2017 is revised to 23,825 ton in MR sheet according to DCS data. Thus, values of monitored parameter in D.2 and Calculation of baseline emissions or baseline net removals in E.1. is changed. The emission reduction was increased to 56.40tCO_2.

Documentation provided by project participant

- Revised Monitoring Report
- Emission Reductions spreadsheet for LG Chem Naju plant.

DOE assessment	**Date:** 19/12/2019

PP appropriately corrected the errors as the actual value for the steam production generated in the calculation of emission reduction. The emission reductions resulting CAR 05 result in about 56 tCO_{2e} increase. Thus, CAR 05 was checked and satisfied. CAR 05 is closed.

CAR ID	CAR 06	**Section no.**	E.6.2	**Date:** 04/12/2019

Description of CAR

Steam information (pressure and temperature for steam) obtained from DCS & PIS form some periods are abnormal. For example (not limited)		
- 25/11/2017	- 30/03/2018 to 31/03/2018	- 27/06/2018 to 28/06/2018
- 21/09/2018 to 22/09/2018	- 26/01/2019 to 28/01/2019	- 25/04/2019 to 26/04/2019
Project participant response		**Date:** 13/12/2019
During the boiler O&M period (25/11/2017, 30/03/2018 to 31/03/2018, 27/06/2018 to 28/06/2018, 21/09/2018 to 22/09/2018, 16/10/2018, 22/10/2018, 25/01/2019, 26/01/2019, 25/04/2019, 26/04/2019), the steam information from DCS is abnormal compare with log sheets. The steam information(pressure and temperature) in the log sheets was normal(about 27kgf/cm^2 and 385℃). And the emission reductions were calculated using the normal data only. So, the some of the emission reductions are related to CAR 03		
Documentation provided by project participant		
- Revised Monitoring Report *- Emission Reductions spreadsheet for LG Chem Naju plant.* *- Data list for Abnormal (included Emission reductions spreadsheet)*		
DOE assessment		**Date:** 19/12/2019
The time-by-time information of the relevant date from DCS and boiler log-sheet was checked and the operation time of the corresponding date was low, indicating that it was an outlier value in the process of weighted averaging to daily unit. Corresponding information has been modified to the extent that the emission reductions have changed. In case of abnormal values for boiler efficiency, PP excluded them from the calculation of emission reduction from a conservative perspective (considering CAR 03). Therefore, the emission reductions resulting CAR 03 & CAR 06 result in about 856tCO_{2e} decrease. Thus, CAR 06 was checked and satisfied. CAR 06 is closed.		

Table 4. FAR from this verification

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

Document information

Version	*Date*	*Description*
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM validation and verification standard for project activities” (CDM-EB93-A05-STAN); • Make structural and editorial improvements.
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.

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: project activities, verifying and certifying