



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

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

BASIC INFORMATION

Title and UNFCCC reference number of the project activity	<ul style="list-style-type: none"> Title: Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea Reference number: 0922
Version number of the verification and certification report	<ul style="list-style-type: none"> Version 02.0
Completion date of the verification and certification report	<ul style="list-style-type: none"> 03/01/2019
Monitoring period number and duration of this monitoring period	<ul style="list-style-type: none"> Monitoring period number: 12th (3rd monitoring period in the 2nd crediting period) Duration: from 27/08/2016 to 31/08/2017
Version number of the monitoring report to which this report applies	<ul style="list-style-type: none"> Version 04
Crediting period of the project activity corresponding to this monitoring period	<ul style="list-style-type: none"> From 27/06/2014 to 26/06/2021
Project participants	<ul style="list-style-type: none"> Hanwha Corporation (HWC)
Host Party	<ul style="list-style-type: none"> Republic of Korea
Applied methodologies and standardized baselines	<ul style="list-style-type: none"> Applied methodology: ACM0019 (version 02) (N₂O abatement from nitric acid production) No standardized baseline(s) applicable
Mandatory sectoral scopes linked to the applied methodologies	<ul style="list-style-type: none"> Sectoral scope: 5-Chemical industries
Conditional sectoral scope(s) linked to the applied methodologies	<ul style="list-style-type: none"> No conditional sectoral scope(s) linked to the applied Methodology
Estimated amount of GHG emission reductions or GHG removals for this monitoring duration in the registered PDD	<ul style="list-style-type: none"> Amount estimated in PDD for 2016 and 2017: 243,330 tCO₂e each → Corresponding estimated amount for the duration of the monitoring period (370 days): 246,432 tCO₂e * 2016: 127 days, 2017: 243 days, Total: 370 days
Certified amount of GHG emission reductions or GHG removals for this monitoring period	<ul style="list-style-type: none"> 287,367 tCO₂e
Name and UNFCCC reference number of the DOE	<ul style="list-style-type: none"> Name: Korean Foundation for Quality (KFQ) Reference number: E-0025

Name, position and signature of the approver of the verification and certification report	Soon Hong YEOM  Managing Director of Sustainability management institute
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SECTION A. Executive summary

Korean Foundation for Quality (hereinafter KFQ) has performed periodic verification of the CDM project "Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC)" in Ulsan, Republic of Korea", UNFCCC Registration Ref. No. 0922 for the period from 27/08/2016 to 31/08/2017. This report contains the findings from the verification and a certification statement for the certified emission reductions.

Verification objective

Verification is the periodic, thorough and independent assessment and ex post determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM project activity during a defined monitoring period. Certification is the written assurance by a DOE that, during a specific period in time, a project activity achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the "Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC)" for the period from 27/08/2016 to 31/08/2017 in accordance with paragraph 62 of CDM modalities and procedures.

Verification scope

The scope of the verification is to verify that:

- The project activity has been implemented and operated in accordance with registered PDD or any approved revised PDD that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place.
- The monitoring report and other supporting documents provided are complete in accordance with latest applicable version of the completeness checklist for requests for issuance of CERs and verifiable and in accordance with applicable CDM requirements.
- The monitoring plan complies with the monitoring methodology and the actual monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved methodology including applicable tools and compliance with any guidance provided by the Board regarding deviations from the provisions of a registered plan and/or methodology.
- Data is recorded and stored as per the monitoring methodology ACM0019 (version 02) and the calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

Furthermore, it was KFQ's objective to identify any concerns related to the conformity of the actual project activity and its operation with the registered project design document and determine whether any deviation or proposed or actual changes in the implementation or operation of the project activity comply with the requirements of the Project Standard.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified. The verification is incorporating both quantitative and qualitative information on emission reductions.

Verification process

KFQ has made publicly available the monitoring report received from the project participants. Only verification activities after the publication of the monitoring report on the UNFCCC CDM website have been used as a basis for conclusion of verification.

The verification process includes desk review of the monitoring report published (and any updated versions, if available), emission reduction calculation spreadsheet and other supporting documents and data. Further, onsite assessments and interviews with those involved in project management and operations are conducted. This is followed by preparation of verification report summarizing desk review and on-site assessment findings (i.e. CARs, CLs, and FARs). Upon successful closing of the CARs and CLs raised (if any), the final verification report is prepared. The final report then undergoes a technical review and final approval according to KFQ's internal quality assurance procedures.

The data presented in the monitoring report were assessed by review of the detailed project documentation and production records, as well as by interviews with personnel at Hanwha Corporation (hereinafter HWC) and observation of collection of measurements, observation of established monitoring and reporting practices and assessment of the reliability of monitoring equipment. This has enabled the verification team to assess the accuracy and completeness of reported monitoring results, as well as to verify the correct application of the approved monitoring methodology. Furthermore, this has enabled the verification team to assess and determine that the implementation and operation of the project activity as well as the steps taken to report emission reductions in compliance with the CDM criteria and relevant guidance provided by the Board.

In addition, all parameters, as required (and as applicable) by the monitoring methodology ACM0019 (version 02) as well as the monitoring plan and the management system were assessed during the site visit.

Description of the project activity

The project activity is to reduce N₂O emissions in the tail gas at nitric acid production process by installation of a DeN₂O catalyst in Onsan plant of HWC. The project activity introduces a tertiary N₂O abatement facility, physically located in the tail gas stream of the nitric acid plant. In order to monitor the N₂O reduction, the tail gas volume flow and the nitrous oxide concentration at the outlet of the DeN₂O unit are monitored through the Automated Measuring System (AMS) including non-dispersion infrared absorption analyzer(NDIR) which is applicable to European standards and norms (EN 14181) and recorded.

The physical components including the equipment for N₂O abatement and monitoring the N₂O reduction were confirmed as proposed in the registered PDD.

Project Title	Catalytic N ₂ O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea
UNFCCC Registration Number	0922
Project Participant	Hanwha Corporation (Republic of Korea)
Baseline and monitoring methodology	ACM0019 (version 02)
Location of the project	Address: 32, Sannam-gil, Onsan-eup, Ulju-gun, Ulsan city GPS Coordinates: Longitude : 129.3392106°E, Latitude : 35.4139980°N
Date of registration	03/05/2007
PDD (2 nd crediting period)	Version 13 of 24/06/2016 (registered) Version 14 of 20/12/2018 (revised)
Validation (2 nd crediting period)	Validation report of 07/05/2014 by DNV

Renewal date	06/08/2014
2 nd crediting period	27/06/2014 to 26/06/2021
Monitoring period of this verification	27/08/2016 to 31/08/2017 (370 days)

Conclusion

KFQ has performed the verification of the emission reductions reported for the project activity “Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan” in the republic of Korea (UNFCCC Registration Ref. No. 0922) for the period from 27/08/2016 to 31/08/2017.

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. All relevant records of data from the ABB data logging, DCS and records from the production logs of the nitric acid production have been examined and verified for the reporting period.

KFQ also confirms that the GHG emission reductions are calculated without material misstatements. Our opinion refers to the project’s GHG emissions and resulting GHG emission reductions reported, both determined using the valid and registered project’s baseline, registered and revised monitoring plan and its associated documents.

The implementation of the project resulted in 287,367 tCO₂e of emission reductions during the monitoring period from 27/08/2016 to 31/08/2017 which is within the renewal, second crediting period from 27/06/2014 to 26/06/2021. In our opinion, the GHG emission reductions reported for the project in the MR (Version 4) are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology ACM0019 (version 02), monitoring plan in the registered and revised PDD.

KFQ is able to certify that the emission reductions from the “Catalytic N₂O destruction project in the tail gas of Nitric Acid Plants of the Hanwha Corporation (HWC) in Ulsan, republic of Korea” during the period from 27/08/2016 to 31/08/2017 amount to 287,367 tCO₂e.

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(*)	IR	LEE	Mi Jung	KFQ	√	√	√	√
2.	Verifier(*)	IR	JEONG	Yu Shim	KFQ	√	-	√	√
3.	Verifier	IR	PARK	Su Hyun	KFQ	√	√	√	√

(*) means a personnel with technical expertise in technical area 5.2.

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	IR	YOON	Sung Han	KFQ
2.	Approver	IR	YEOM	Soon Hong	KFQ

Please refer to Appendix 2 below for demonstration of how the team meets the competence required for the verification.

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.	<i>Number of Monitoring parameters</i>	<i>L</i>	<i>Methodology and tool require a rather low number of monitoring parameters</i>	<i>The KFQ verification team included three verifiers in total and two of them participate in on-site to cover/ review all monitoring parameters in a complete and detailed manner. In the previous verification, there was no significant change on verified ER compared to ER in Monitoring report (version 1)</i>
2	<i>Error rate in Monitoring report'</i>	<i>M</i>	<i>Expert organization is involved in compilation of MR as well as calculation</i>	<i>In response of that risk, the KFQ verification team focuses on systematic consistency and error checks.</i>
3	<i>Familiarity with Monitoring system</i>	<i>M</i>	<i>This is 12th monitoring period (3rd period of second crediting period). Expert organization is involved in the periodic inspection of monitoring equipment</i>	<i>In response to that risk, the KFQ verification team checks the existence of any and all monitoring instruments as well as their valid calibration, independently from the fact that the PP would already be familiar with the monitoring system. Nevertheless, the relatively new parts of the monitoring system was introduced in the 2nd crediting period will be checked especially.</i>
4	<i>QA/QC</i>	<i>L</i>	<i>Stable QA/QC system has been implemented</i>	<i>The KFQ verification team focuses on periodic calibration and QA/QC activities performed as per EN 14181 and application of calibration result in raw data. Additionally, the KFQ verification team also focuses on crosschecking as well as plausibility check in order to ensure data quality.</i>
5	<i>Data flow</i>	<i>L</i>	<i>Most data are transmitted to the spreadsheet</i>	<i>In response to that risk, the KFQ verification team checks</i>

			<i>automatically</i>	<i>the safeguard measures for raw data and crosschecks raw data with the MS Excel spreadsheets on a random sampling basis in order to ensure the functioning of the transferring system..</i>
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KFQ's verification plan draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. KFQ planned the verification by obtaining evidence and other information and explanations that KFQ considers necessary to give reasonable assurance on the reported GHG emission reductions on the basis of risk level identified and materiality concept in accordance with "Guideline of application of materiality in verifications (ver. 02).

C.2. Consideration of materiality in conducting the verification

The detected findings could impact the amount of emission reductions, but occurred in isolation and is immaterial. As the finding could be considered as simple error, not systematic reoccurring error, the verification team decided that no additional audit procedures need to be conducted in order to reach a reasonable level of assurance, and that the claimed emission reductions in the MR are free from material error, omission or misstatement. Accordingly, verification and sampling plan were not revised.

SECTION D. Means of verification

D.1. Desk/document review

KFQ's verification is based on the monitoring documentation provided by the PP especially the MR (Version 1.0 dated 27/03/2018, published on 29/03/2018) and the CDM Project spreadsheets. Furthermore, the registered PDD, the revised PDD and validation report were reviewed as well as the monitoring plan, previous verification reports, the applied baseline and monitoring methodology and any other information and references relevant to the project activity's emission reductions (e.g. IPCC reports, etc.). A complete list of all documents reviewed is shown in Appendix 3 of this verification report. KFQ's verification process takes into consideration all the CDM Rules and Guidance applicable to the project activity, e.g. CDM Validation and Verification Standard for Project Activities, Clean Development Mechanism Project Standard, Clean Development Mechanism Project Cycle Procedure, Checklist for requests for post-registration changes to project activities and Checklist for requests for issuance for project activities and relevant decisions, clarifications and guidance from the CMP and the CDM EB.

During the desk review, KFQ has applied standard auditing techniques to assess the quality of information provided. The following activities were performed:

- Verify the compliance of the MR with the guidance for completing the monitoring report form;
- Verify the completeness of the data and the information presented;
- Review the monitoring plan and monitoring methodology. Check the compliance of the MR with respect to the monitoring plan and verify that the applied methodology was carried out. Particular attention to coverage of all monitoring parameters, the frequency of measurements, the quality of the metering equipment including calibration requirements and the quality assurance and quality control procedures was paid;
- Review the calculations and assumptions used to obtain GHG data and ER;

- Evaluate the data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

D.2. On-site inspection

Detailed verification of all data contained in the MR was performed during the site visit at Onsan plant of HWC on 19/04/2018. During the site visit, the personnel were interviewed or assisted the verification team. During the on-site assessment, KFQ has applied standard auditing techniques to assess the quality of information provided. The following aspects of the CDM project activity have been confirmed:

- The implementation and operation of the CDM project activity;
- The information flow for generating, aggregating, recording, calculation and reporting of the monitoring parameters; and
- The operational and data collection procedures and their implementation in accordance with the monitoring plan.

Further, the following activities were performed:

- A cross-check between information provided in the MR and data from other sources such as plant log books, inventories, nitric acid production records, or similar data sources;
- A check of the monitoring equipment including calibration performance and observations of monitoring practices against the requirements of the PDD, the monitoring plan and ACM0019 (Version 02);
- A review of calculations and assumptions made in determining the GHG data and emission reductions; and
- An identification that quality control and quality assurance procedures are in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

Duration of on-site inspection: 19/04/2018				
No.	Activity performed on-site	Site location	Date	Team member
1.	Confirmation of the correct & complete implementation and operation of the Project Activity and check of all physical features as described in the PDD are in place.	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK
2	Review of the complete data flow from data generation, aggregation, recording, calculation to reporting of the monitoring parameters	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK
3	Confirmation of the complete & correct implementation of procedures for the operation and data collection.	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK
4	Verification of the information provided in the MR and documentation with other sources.	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK
5	Check of the monitoring equipment against the PDD, the monitoring plan as well as the approved methodology, including check of calibration & maintenance, etc. in relation to that equipment.	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK
6	Identification whether suitable QA/QC procedures are in place in order to prevent errors or to enable the corrections of errors and omissions in the reported parameters.	Onsan plant	19/04/2018	Mi Jung LEE Su Hyun PARK

D.3. Interviews

A list of the persons interviewed during this verification activity is included in table below.

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	LEE	Gwang Yeol	HWC	19/04/2018	Facilities, instruments and analysis, QA/QC calculation	Mi Jung LEE Su Hyun PARK
2	PARK	Sung Gong	HWC	19/04/2018	General support	Mi Jung LEE Su Hyun PARK
3	Hong	Hye Jin	HWC	19/04/2018	General support	Mi Jung LEE Su Hyun PARK
4	KIM	Yeah Won	Roen Consulting Co., Ltd.	19/04/2018	CDM coordination	Mi Jung LEE Su Hyun PARK
5	Yoon	Dong Gil	Daekwang Inc.	14/12/2018	Monitoring equipment manufacture	Su Hyun PARK

D.4. Sampling approach

As per the requirements set out in CDM Validation and Verification Standard for Project Activity (Version 02.0), random sampling has been applied, as relevant for the present case in the Project Activity, where no sampling approach was applied by the PP.

Since automatic transferred system to the spreadsheet is in place, crosscheck for data in spreadsheet against raw data were done based on random sampling after confirming safeguard measure for raw data in DCS and server and transferring system. In addition, recalculations for all

events, the locations, calibrations of all measurement instruments and intervals (Measuring frequency, Reading frequency and Recording frequency) were assessed.

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

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
Compliance of the monitoring report with the monitoring report form	1	0	0
Compliance of the project implementation and operation with the registered PDD	0	1	0
Post-registration changes	0	0	0
Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines	1	0	0
Compliance of monitoring activities with the registered monitoring plan	6	0	0
Compliance with the calibration frequency requirements for measuring instruments	0	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	9	1	0

The objective of this phase of the verification was to resolve any issues which were needed to be clarified prior to KFQ's conclusion that i) the project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD, ii) the monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan including any guidance provided by the Board regarding deviation from the provisions of a registered/revised plan and/or methodology and iii) the data and calculation of GHG emission reductions are correct.

A corrective action request (CAR) is issued, where:

- Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by PP, or if the evidence provided to prove conformity is insufficient;
- Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by PP;
- Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impact the quantity of emission reductions;
- Issues identified in a FAR during validation or previous verification(s) to be verified during next verification have not been resolved by PP.

A clarification request (CL) shall be raised if information is insufficient or not clear enough to determine whether the applicable CDM rules and requirements have been met.

A forward action request (FAR) is issued for actions if the monitoring and reporting require attention and/or adjustment for the next monitoring period.

9 CLs and 1 CAR were raised for this monitoring period, which were closed successfully after PP have submitted MR Version 04.

SECTION E. Verification findings**E.1. Compliance of the monitoring report with the monitoring report form**

Means of verification	KFQ has checked the MR provided by the PP against the latest MR form in order to determine whether the MR is in compliance with it.
Findings	<p>It was found that there are no deviations between the MR (version 4) and the latest monitoring report form (version 06.0).</p> <p>However, as per instruction for completing CDM-MR-FORM, PP has to provide information of PRCs approved by EB as applicable from prior to this monitoring period but PP didn't provide the information of approved PRCs (ref. no. PRC-0922-001, PRC-0922-002) in the section B.2 of MR (version 1). (<u>Refer to Appendix 4 / CL ID 01</u>). After PP revised MR (version 4), information of all PRCs (PRC-0922-001, PRC-0922-002, PRC-0922-003 and being submitted with this MR under issuance track) are completely stated in the section B.2. of MR (version 4).</p>
Conclusion	<p>The raised CL ID 01 has been completely resolved.</p> <p>The verification team concludes that the MR (version 4) is in compliance with the latest monitoring report form (version 06.0) and the instructions therein.</p>

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

FAR was not issued from validation and previous verifications.

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

Means of verification	<p>Physical project implementation</p> <p>During the on-site visit, the KFQ verification team visually inspected the installations of the DeNOx system and all instrumentations necessary for the monitoring of the emission reductions and checked whether all physical features of the CDM Project activity, including the data collection systems and storage, have been implemented in accordance with the registered PDD. Also, the KFQ verification team reviewed the documentation with regard to start-up and operation of the DeN₂O system, monitoring instrument specifications including containing details such as instrument history and measuring ranges.</p> <p>Project operation</p> <p>The verification team checked the operational records and other relevant information (Appendix 3) and interviewed relevant plant staff on the actual operation. Also daily reports, event log files, maintenance & calibration reports and logging data were checked by the KFQ verification team, especially with regard to times with shutdowns and issues, as indicated in the monitoring report.</p>
Findings	<p><u>Compliance of the project implementation with the registered PDD</u></p> <p>The commercial operation of the nitric acid plant was started in January in 2005 and the project was registered on 03 May 2007. And then, the DeN₂O unit has been in operation since 27 June 2007 and it was confirmed by checking the operation and Certificates of Guarantee test run issued by the catalyst and reactor supplier. By operation of DeN₂O unit on 27 June 2007, PP has changed the starting date of crediting period from 01 July 2007 to 27 June 2007, and this change was accepted by UNFCCC. As the termination of the 1st crediting period, the project was renewed on 06 Aug 2014 and it starts the 2nd crediting period for 27/06/2014~26/06/2021. The verification team confirmed it through the information of UNFCCC and interview at on-site.</p> <p>In addition, the change of physical location of DeN₂O units to the front of the tail gas turbine was completed on 29 Nov. 2015 in order to enhance removal efficiency of N₂O reduction as described in the registered PDD (please refer to Appendix 7 of the revised PDD (version 14) as well as PRC-0922-002). The change on physical</p>

	<p>location of DeN₂O units has been checked through construction completion report of switching location of DeN₂O unit, on-site inspection and interview with the PP.</p> <p>The project was implemented and maintains its operation as described in the registered and revised PDD. During the on-site visit, KFQ inspected the installation of the DeN₂O Unit and all instrument necessary for the monitoring of the emission reductions. All physical features (technology, project equipment and monitoring/metering equipment) of the project are in place as per the registered and revised PDD.</p> <p>The verification team confirmed through visual inspection and instrument specifications containing history and measuring range that all physical features of the CDM project activity including data collection systems and storage have been implemented in accordance with the registered and revised PDD.</p> <p><u>Actual operation of the project during the monitoring period:</u></p> <p>For this monitoring period, lasting 370 days, the operation of the nitric acid plant and DeN₂O unit were temporarily stopped due to the reasons given in the MR.</p> <p>However, it identified that there were 7 times of shutdown this monitoring period in the MR (version 1) but description and shutdown period of it in ER calculation spreadsheet is inconsistent. Further to this, PP explained that emission reduction for this shut-down is treated as '0' in MR (version 1.0) but it was not reflected in ER calculation. (<u>Refer to Appendix 4 / CAR ID 01</u>). Regarding to CAR ID 01, PP revised number of events during this monitoring period as well as actual shut-down period according to ABB data logging system and DCS system. In this event, abnormal operation such as DCS system failure and non-stationary data recording included. In addition, PP re-calculated baseline emission to apply '0' for identified event period in a conservative manner. Thus, KFQ checked documented shut down reports, the daily operation records, ABB data logging and DCS etc., and also interviewing relevant plant staff of HWC to confirm event mentioned in MR (version 4.0) are well stated without any omission to be considered.</p> <p>KFQ confirms that baseline emissions were regarded as zero for those above mentioned event periods and it is clearly and correctly reflected in ER calculation.</p> <p>In addition, the events regarding to the operation of the DeN₂O unit mentioned in the MR were confirmed by KFQ through checking the daily operation record and data logging system. It is identified that baseline emissions are conservatively applied during operational events of the plant.</p>
Conclusion	<p>The raised CAR ID 01 has been completely resolved.</p> <p>KFQ confirms that the project has been implemented according to the description in the registered PDD.</p> <p>The verification team specifically confirms that</p> <ul style="list-style-type: none"> • All physical features of the proposed CDM project activity including data collection systems and storage are in place and in accordance with the registered and revised PDD; and • All other relevant information provided in the monitoring report is fully in accordance with respective information stated in the registered and revised PDD; and • The information on project operation, the management system and quality assurance are complete, correct and in accordance with the registered and revised PDD and; • The management system and quality assurance and related procedures have implemented as described in the monitoring report and in accordance with the registered and revised PDD.

E.4. Post-registration changes

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

There was one approved temporary deviation from registered monitoring plan applied to this monitoring period as below:

1. Approval date and ref. No.: 18/07/2017 (ref. No. PRC-0922-003)
 - Temporary deviation period: 01/06/2016 ~ 20/09/2016
 - Application period of temporary deviation to this monitoring period: 27/08/2016~20/09/2016
 - Reason for deviation: With regard to an issue (QAL1 test of $V_{t,db}$), the applicable period for the previous deviation (PRC-0922-001) was set during 27/06/2014 ~ 31/05/2016 in consideration of planned installation date of new flowmeter with QAL1 certificate. However, the installation of new flowmeter with QAL1 certificate has been delayed due to the delivery postponement of manufacturer (DURAG), and the new flowmeter with QAL1 certificate was installed on 20/09/2016. Thus, a new temporary deviation was submitted to the EB and it was approved on 18/07/2016 (Effective approval date: 17/07/2017)

Other temporary deviation from registered monitoring plan has applied to previous monitoring period, 11th monitoring period:

2. Approval date and ref. No.: 26/04/2016 (ref. No. PRC-0922-001)
 - Temporary deviation period: 27/06/2014 ~ 31/05/2016
 - Application period of temporary deviation to this monitoring period: N/A
 - Reason for deviation: As for the compliance with the EN14181, the suitability test of QAL1 was not available for the flowmeter ($V_{t,db}$), therefore, HWC decided to proceed the temporary deviation for ensuring quality assurance of the data on the flow meter as per paragraph 100 of EB 47th meeting report. (Effective approval date: 24/04/2016)

Please refer to the relevant PRC validation report (23/12/2015 for PRC-0922-001, 22/05/2017 for PRC-0922-003) for details.

E.4.2. Corrections

There is another correction to be submitted and request for approval under issuance track of this monitoring period. As per the applied methodology ACM0019 version 2, parameter ' $P_{production,y}$ ' which is production of nitric acid in year y is used for calculation of baseline emissions. But in the registered PDD (version 13), the parameter is written as ' $P_{product,y}$ ' with typographical errors. In order to be in accordance with the applied methodology, PP revised PDD (version 14) and corrected typo of the parameter as ' $P_{production,y}$ '. Please refer to the PRC validation report (Version 01.1, 02/01/2019) for details.

There was a request for prior approval of correction submitted on 06/07/2016 with regard to accuracy level of NDIR. The correction was approved on 19/09/2016 (effective approval date: 18/09/2016) by EB. The reference number of the PRC is PRC-0922-002 and please refer to the PRC validation report (06/07/2016 for PRC-0922-022) for details.

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

There were no post registration changes identified by verification team during this verification.

E.4.4. Inclusion of a monitoring plan

There were no post registration changes identified by verification team during this verification.

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

There is permanent changes to request for approval under issuance track of this monitoring period. Please refer to the PRC validation report (Version 01.1, 02/01/2019) for details.

1. Changes of the nitric acid flow meter: PP exchanged a flow meter with new meter in order to improve accuracy of the meter. Accordingly, PP revised registered PDD (version 14) to reflect specification of a new flow meter.
2. Measuring of the nitric acid concentration: Although concentration of nitric acid produced has to be monitored for calculation of the amount of nitric acid produced but monitoring of HNO₃ concentration was not provided in detail in the registered monitoring plan of PDD (version 13). Thus, PP decided to revise registered monitoring plan to provide clear monitoring plan of it. PP described monitoring plan of HNO₃ concentration in revised PDD (version 14).

Prior to this monitoring period, there was a request for prior approval of permanent changes from registered monitoring plan submitted on 06/07/2016 with regard to 'Deletion of parameters as per the fossil fuels used for operation of a DeN2O unit', 'Change of 'source of data' in the parameters' and 'Installation of new flow meter with QAL1 to the provision of EN14181'. The permanent changes were approved on 19/09/2016 (effective approval date: 18/09/2016) by EB. The reference number of the PRC is PRC-0922-002 and please refer to the PRC validation report (Version 01, 06/07/2016) for details.

E.4.6. Changes to the project design

There was a request for prior approval of changes to the project design of a registered project activity submitted on 06/07/2016 with regard to the change of location for DeN2O unit. The changes to the project design was approved on 19/09/2016 (effective approval date: 18/09/2016) by EB. The reference number of the PRC is PRC-0922-002 and please refer to the PRC validation report (06/07/2016 for PRC-0922-022) for details.

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

N/A

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

Means of verification	The KFQ verification team reviewed the monitoring plan contained in the registered PDD against the approved methodology, ACM0019 (Version 2) and the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 3) which is applied by the project activity.
Findings	<p>The KFQ verification team found that there are no incompliance between the applicable registered and revised monitoring plan, the applied methodology ACM0019 (Version 2) and the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 3).</p> <p>However, the verification team identified that version of applied methodology (ACM0019) in MR (version 1) is 3 which is inconsistent with the registered PDD. Further to this, as per the applied methodology ACM0019 (version 2), parameter ‘P_{production,y}’ which is production of nitric acid in year y is used for calculation of baseline emissions. But it is found that the parameter is written as ‘P_{product,y}’ in section of E.1. of MR (version 1) and also in the registered PDD (version 13). (Refer to Appendix 4 / CL ID 02).</p> <p>After PP submitted revised MR (version 4), it is found that all typographical errors of the version of applied methodology (ACM0019) and parameter, ‘P_{production,y}’ are correctly indicated in the MR (version 4) and revised PDD (version 14).</p> <p>Furthermore, it was found that there are no standardized baselines applied in the project activity.</p>
Conclusion	<p>The raised CL ID 02 has been completely resolved.</p> <p>KFQ confirms that the registered and revised monitoring plan is in accordance with the approved methodology applied by the project activity, ACM0019 (Version 2) and “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 3). There is also no applicable standardized baseline for the project activity.</p>

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	'Data and parameters fixed ex-ante' listed in the MR have been crosschecked & reviewed against – as applicable – the monitoring plan contained in the registered and revised PDD as well as applied methodology (ACM0019 _version 02) including applicable tools and other relevant CDM related documentation.			
Findings	'Data and parameters fixed ex-ante' have been reviewed against the registered and revised PDD, applied methodology (ACM0019 _version 02) and Tool to determine the mass flow of a greenhouse gas in a gaseous steam (version 3.0.0).			
	Detailed assessment on 'Data and parameters fixed ex ante' is as below;			
	Data/parameter (unit, description)	Source of data	Value(s) applied	Assessment
	• Operating pressure (KPa, Operating pressure of the Ammonia burner)	Manufacturer specifications	High pressure	According to the historical records of the operating condition of the ammonia burner, all the recorded hourly operating pressure were higher than 600kPa, thus, according to the methodology, high pressure's default N ₂ O baseline emission factor is applied for this project.
• EF _{historical}	Historical	9.47	For plants that used	

	(kgN ₂ O/tHNO ₃ , Historical baseline emission factor of the Nitric acid plant)	information from issuance reports of CDM-PDD documents		AM0028 in the first crediting period, the lowest baseline emission factor obtained in one calendar year during the 1 st crediting period.
	• EF _{default,y} (kgN ₂ O/tHNO ₃ , Default emission factor according to the operating pressure of the ammonia burner in year y)	PDD / ACM0019 (ver. 2)	12.0(in 2016) 11.8(in 2017)	According to the applied methodology, EF _{default,y} during the year of 2016, 2017 is 12.0 and 11.8 kgN ₂ O/tHNO ₃ respectively. The default N ₂ O emissions factors are correctly applied in the MR as per the applied methodology.
	• EF _{new,y} (kgN ₂ O/tHNO ₃ , Baseline N ₂ O emission factor for nitric acid production in year y)	PDD / ACM0019 (ver. 2)	3.20(in 2016) 3.00(in 2017)	According to the applied methodology, EF _{new,y} during the year of 2016, 2017 is 3.20 and 3.00 kgN ₂ O/tHNO ₃ respectively. The default N ₂ O baseline emissions factors are correctly applied in the MR as per the applied methodology.
	• P _{product, max} (t Product, Design capacity of nitric acid production during the 1 st crediting period)	PDD	107,100	According to the applied methodology, P _{product, max} should be the designed capacity applied during the 1 st crediting period. In the registered PDD, the value of 107,100t/y was applied.
	• GWP _{N2O} (tCO ₂ e/tN ₂ O, Global warming potential of N ₂ O)	Relevant decision by the CMP	298	According to the "Application of the global warming potentials to clean development mechanism project activities and programme of activities for the second commitment period of the Kyoto Protocol", all the CDM project shall apply updated GWP value since 1 January 2013. For N ₂ O, the value of 298 shall be applied from 1 January 2013 onwards.
	• Ru (Pa.m ³ /kmol.K, Universal ideal gases constant)	PDD / "Tool to determine the mass flow of a greenhouse gas	8,314	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous

		in a gaseous stream" (ver. 3.0.0)		steam, version 3.0.0", the universal ideal gases constant is 8,314 Pa.m ³ /kmol.K.
	• M _{Mi} (kg/kmol, Molecular mass of greenhouse gas i)	PDD / "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (ver. 3.0.0)	44.02	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 3.0.0", the molecular mass of N ₂ O is 44.02 kg/kmol.
	• P _n (Pa, Total pressure at normal condition)	PDD / "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (ver. 3.0.0)	101,325	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 3.0.0", Total pressure at normal condition is 101,325Pa.
	• T _n (K, Temperature at normal conditions)	PDD / "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (ver. 3.0.0)	273.15	According to "Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 3.0.0", Temperature at normal conditions is 273.15K.
<p>However, it is identified that EF_{default,y} and EF_{new,y} for year 2016 and 2017 are not provided in Section D.1 of the MR (version 1). (Refer to Appendix 4 / CL ID 03).</p> <p>To response the above mentioned CL ID 03, PP submitted revised MR (version 4). PP indicated relevant EF_{default,y} and EF_{new,y} for this monitoring period. The verification team confirms that the parameters have been properly updated according to the registered, revised PDD and it is correctly applied in ER calculation.</p> <p>Furthermore, figure of P_{product, max} in the registered PDD is 107,100 t HNO₃ and it is for the 1 year, 365 days. Therefore, it has to be adjusted according to this monitoring period (370 days). However, P_{product, max} is not adjusted for this monitoring period. (Refer to Appendix 4 / CL ID 04). After the PP has submitted the revised MR (version 04), PP re-calculated P_{product,max} according to the monitoring period (127 days for year 2016 and 243 days for year 2017) as 108,465 t HNO₃. And it is well reflected in ER calculation.</p> <p>Lastly, emission reduction is correctly calculated in the latest MR (version 04) and ER calculation sheet (version 03).</p>				
Conclusion	<p>The raised CL ID 03 and 04 have been completely resolved.</p> <p>KFQ confirms that all data and parameters fixed ex-ante such as emission factors, etc. are explicitly mentioned in the MR and have been correctly and consistently applied.</p> <p>All values are in compliance with relevant documentation such as the registered and revised PDD & monitoring plan as well as the applied methodology, applied tools and other CDM related documentation, where applicable.</p>			

E.6.2. Data and parameters monitored

The monitoring report lists each parameter required by the monitoring plan and the information flow for each parameter is provided in the MR. The verification team confirms that the MR includes all parameters and the monitored data at the interval required by the methodology and the monitoring

plan contained in the registered PDD (version 13) and revised PDD (version 14). The monitoring has been carried out in accordance with the monitoring plan, and all parameters were monitored and determined as per the monitoring plan. The completeness of monitoring and compliance with monitoring plan were assessed and summarized as below;

Information flow

The common data flow systems have been used in the project activity for the following parameters:

- Nitric acid production ($P_{\text{production},y}$)
- Operating parameter of the nitric acid plant (flow of HNO_3 produced for determining h_y)
- Volumetric flow, temperature and pressure of the tail gas stream ($V_{t,db}$)
- Volumetric fraction of N_2O in the tail gas stream ($v_{i,t,db}$)

The data from each transmitter, detector and flow meter is continuously measuring and transferred to ABB data logging system and DCS system. Thus, collected and processed data, i.e. calculation, raw data, calculated values, are stored in the server continuously and available in the network system as digital values. Also it is generated aggregated monthly data sheets based on the raw data stored at the delegated server.

The verification of the information flow (where applicable) of all monitoring parameters was successfully done by means of the following documents and cross checks.

Data generation and aggregation:

- Monthly data sheet from ABB data logging system
- Data sheet downloaded from DCS system for the monitoring period
- Calibration records and certificates on instrument
- Certificate of analysis of the standard test gas for analyzer calibration

Aggregation to recording:

- Data cross check between values from analyzers / transmitters and values in control room

Calculation and reporting:

- Crosscheck of implemented calculations in Excel sheets against the PDD formulae

The verification team assessed the information flow and data collection system and confirms that it meets the requirements of the registered PDD, the revised PDD and the monitoring plan as per the applied methodology ACM0019 (version 02). In addition, Intervals (measuring frequency, reading frequency, recording frequency) of each instrument are also verified through display panel at on-site and DCS generated reports, and concluded that Intervals were set in accordance with ACM0019 (version 02), monitoring plan contained in the registered PDD and revised PDD.

Detailed assessment on data and parameters monitored is described as below;

Data/Parameter	$P_{\text{production},y}$
Data Unit	tHNO ₃
Description	Nitric acid produced in the monitoring period n
Source of data used	<ul style="list-style-type: none"> - DCS monthly sheet (for flow of nitric acid), - Daily analysis sheet (for HNO₃ concentration) - Measuring device (Flow meter, specific gravity hydrometer, thermometer)
Value(s)	108,863 tHNO ₃ (total value in this monitoring period) - 27/08/2016 ~ 31/12/2016: 37,530 tHNO ₃ - 01/01/2017 ~ 31/08/2017: 71,333 tHNO ₃

Means of verification	<p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. The verification team checked the DCS monthly sheet and daily analysis sheet for HNO₃ concentration, also compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p>																				
Findings	<p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR (version 04). All specifications in relation of this parameter are fulfilled and suitable instruments and ranges are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The nitric acid production (as 100% HNO₃) is determined based on ‘produced HNO₃ flow’ and ‘produced HNO₃ concentration’.</p> <p>Produced HNO₃ flow is automatically monitored by a Coriolis mass flow meter at the product line before storage tanks. The measured amount of HNO₃ from flow meter is sent to the DCS and recorded in DCS monthly sheet.</p> <p>During this monitoring period, PP changed the flow meter as below:</p> <table><tr><td></td><td colspan="2">Previous flow meter</td><td>Current flow meter</td></tr><tr><td>Manufacturer</td><td colspan="2">Endress + Hauser</td><td>EMERSON</td></tr><tr><td>Model No.</td><td colspan="2">J405D802000</td><td>CMF200L518N2BIEZZZ</td></tr><tr><td>Date of replacement</td><td>22/09/2016</td><td>29/06/2017</td><td>05/02/2018</td></tr><tr><td>Reason</td><td>Conducting calibration of a previous flow meter</td><td>prevent corrosion of meter</td><td>Conducting calibration of a previous flow meter</td></tr></table> <p>For more details regarding to change of the flow meter, please refer to section E.7. in this VCR and PRC validation report (Version 01.1, 02/01/2019).</p> <p>However, during on-site inspection, PP did not provide explanation on how HNO₃ concentration was monitored and reflected in P_{production,y} calculation. (Refer to Appendix 4 / CL ID 05). Regarding to CL ID 05, PP decided to revise registered monitoring plan to provide clear monitoring plan of ‘P_{production,y}’. PP described the information of monitoring HNO₃ concentration in revised PDD (version 14). Please refer PRC validation report (version 01.1, 02/01/2019) for further details.</p> <p>The staffs measure specific gravity and temperature of HNO₃ produced on a daily basis using a specific gravity hydrometer and a thermometer. To determine HNO₃ concentration, specific gravity method is applied with daily measured specific gravity and temperature. This approach is designed by nitric acid plan engineering company, UHDE and validation team checked it through technical standard/manual provide by UHDE. HWC uses data of specific gravity and temperature of HNO₃ measured at noon by default to determine HNO₃ concentration of the day. In case data at noon was not available, HWC compares two alternatives nearest measurement data from the noon (before PM 12:00 and after) and adopts conservative value. The validation team checked that HWC manages HNO₃ concentration in constant level with no significant change during a period of normal operation in order to maintain product quality. In addition, above mentioned method of determination of HNO₃ concentration is well reflected in HWC’s internal manual. The verification team confirms that calculation of HNO₃ concentration is well implemented for this monitoring period according to the monitoring plan of revised PDD (version 14).</p>		Previous flow meter		Current flow meter	Manufacturer	Endress + Hauser		EMERSON	Model No.	J405D802000		CMF200L518N2BIEZZZ	Date of replacement	22/09/2016	29/06/2017	05/02/2018	Reason	Conducting calibration of a previous flow meter	prevent corrosion of meter	Conducting calibration of a previous flow meter
	Previous flow meter		Current flow meter																		
Manufacturer	Endress + Hauser		EMERSON																		
Model No.	J405D802000		CMF200L518N2BIEZZZ																		
Date of replacement	22/09/2016	29/06/2017	05/02/2018																		
Reason	Conducting calibration of a previous flow meter	prevent corrosion of meter	Conducting calibration of a previous flow meter																		

	<p>Consequently, the measured amount and the concentration of HNO_3 is input in ER sheet and converted to the amount of HNO_3 as 100%.</p> <p>Also the verification team checked competency of HWC's measurement staff by reviewing HWC's internal assessment reports. Also the verification team conducted re-calculation with daily measured values of specific gravity and temperature and compared it with the values reported in ER sheet (version 03).</p> <p>The calibration and maintenance routines for the parameter are the responsibility of HWC. The QA/QC and related procedures are covered by the ISO 9001 Quality Management Procedures of the nitric acid plant and considered appropriate by the verification team. Valid calibration certificates covering the whole monitoring period are available for the used equipment. It was found that the calibrations were carried out for a measuring range comparable with the actual measuring range and that the calibrations confirmed proper functioning of the monitoring equipment. Please refer to section E.7. below for calibration.</p>
Conclusion	<p>The raised CL ID 05 has been completely resolved.</p> <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan in the registered and revised PDD and any monitoring activities comply with it.</p> <p>KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan in the registered and revised PDD, the applied methodology as well as methodological tools. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p>

Data/Parameter	h_y
Data Unit	H
Description	Number of hours of operation in a monitoring period y
Source of data used	Measuring device (Nitric acid flow meter)
Value(s)	8,348 (total value in the monitoring period) - 27/08/2016 ~ 31/12/2016: 2,890 h - 01/01/2017 ~ 31/08/2017: 5,458 h
Means of verification	<p>Measurements by nitric acid flow meter have been chosen in order to determine whether or not the nitric acid plant is in operation.</p> <p>KFQ has checked whether this has been correctly determined in the MS Excel sheets based on measured data in accordance with the PDD and the monitoring plan.</p>
Findings	<p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instruments and ranges are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>According to the monitoring plan, measurements by nitric acid flow meter have been chosen in order to determine whether or not the nitric acid plant is in operation. 'h_y', is counted considering only the normal operation hour. The scheduled shutdown, overhaul and non-stationary period of the nitric acid plant, the DCS system failure are well excluded. It was found that the determination of the parameter based on measured values has been implemented correctly in the spreadsheets and is traceable and transparent. Values over the monitoring period are correct.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of HWC. The QA/QC and related procedures are covered by the ISO 9001 Quality Management Procedures of the nitric acid plant and considered appropriate by the verification team. Valid calibration certificates covering the whole monitoring period are available for the used equipment. It was found that the calibrations were carried out for a measuring range comparable with the actual measuring range and that the</p>

	<p>calibrations confirmed proper functioning of the monitoring equipment. Please refer to section E.7. below for calibration.</p> <p>h_y for this monitoring period is finally determined as 8,348h which is increased compare to the MR (Version 1.0) due to PP's response to CAR ID 01 and the verification team confirmed that it is correctly indicated in MR (Version 4.0) and reflected in ER calculation.</p>
Conclusion	<p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that the source of data from HNO_3 flow meter reflects the operating condition of the plant.</p> <p>KFQ confirms as well that the monitoring of 'h_y' has been carried out in accordance with the monitoring plan.</p> <p>KFQ confirms that the QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p>

Data/Parameter	$h_{r,y}$
Data Unit	H
Description	<p>Number of hours of operation in year y where: For tertiary N_2O abatement, the abatement system is by-passed, underperforming or failed.</p>
Source of data used	Measuring device
Value(s)	0
Means of verification	<p>According to the applied methodology, this parameter is determined based on measured data, applying following formula.</p> $F_{\text{N}_2\text{O,tail gas,h}} > EF_{\text{existing,y}} \times P_{\text{NA,h}}$ <p>KFQ has thus checked, whether the parameter has been correctly determined in the MS Excel sheets based on the measured data, in accordance with the PDD and the respective monitoring plan as well as the applied methodology.</p>
Findings	<p>It was found that the determination of this parameter based on measured values has been correctly implemented in the excel spreadsheets and been done without errors. $h_{r,y}$ is calculated by the equation of Case 1(For nitric acid plants that have used AM0028 in the 1st crediting period) in the methodology and values over the monitoring period are correct.</p> $F_{\text{N}_2\text{O,tail gas,h}} > EF_{\text{existing,y}} \times P_{\text{NA,h}}$ <p>$h_{r,y}$ for this monitoring period is finally determined as 0 h which is decreased compare to the MR (Version 1.0) due to PP's response to CAR ID 01 and the verification team confirmed that it is correctly indicated in MR (Version 4.0) and reflected in ER calculation.</p>
Conclusion	<p>KFQ confirms that the monitoring (determination based on measured parameters) of this parameter has been carried out in accordance with the monitoring plan and any related monitoring activities comply with it.</p> <p>KFQ confirms as well that the monitoring of 'h_y' has been carried out in accordance with the monitoring plan.</p> <p>KFQ confirms that the QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p>

Data/Parameter	$V_{t,db}$
Data Unit	Nm^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data used	Measuring device (flow meter)
Value(s)	358,048,346 Nm^3 dry gas (Total volume in the monitoring period)
Means of verification	<p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. Furthermore, the KFQ verification team performed data checks between trend curves (generated from raw data) and monthly data sheet from ABB data logging system. Furthermore, the verification team checked the monthly sheet and</p>

	<p>the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan, the applied methodology and the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0.0).</p> <p>Furthermore, procedures and records on calibration, maintenance as well as QA/QC and EN 14181 related activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p>
Findings	<p>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. It was found that differential pressure transmitter was changed with new one of different model on 20 September 2016. The verification team checked its installation during on-site inspection and by reviewing daily working log on the day of installation. The verification team reviewed its specification provided by manufacture (DURAG). Thus the verification team could conclude that all specifications in relation of this parameter are fulfilled and suitable instrument and range are used.</p> <p>It was found that the data from each transmitters and detector for $V_{t,db}$ is continuously measuring (read every 1 second) and average values are hourly recorded based on temperature and pressure compensated flow rate. And it is transferred to ABB data logging system.</p> <p>Monitoring results are fully available at the required intervals for the whole monitoring period. However volumetric flow of the tail gas shall be adjusted according to the description of calculation method for $V_{t,db}$ in the section D.2. of the MR (version 1.0) but the verification team could not confirm whether this adjustment process is considered in $V_{t,db}$ calculation or not. Further to this, the value of $V_{t,db}$ in MR (Version 1.0) and ER calculation spreadsheet (Version 1.0) are inconsistent. (Refer to Appendix 4 / CL ID 06). Regarding to CL ID 06, PP explained how $V_{t,db}$ for this monitoring period was calculated based on minute/hourly data of volumetric flow of the tail gas. The verification team reviewed data of volumetric flow of the tail gas and could confirm that there was no period where the volume of the tail gas are not available for more than 1/3 of any hour while the plant was in operation. Regarding to the inconsistency of $V_{t,db}$ in MR and ER calculation spreadsheet, PP revised MR (Version 4.0) and ER calculation spreadsheet (Version 3.0) to reflect final calculated $V_{t,db}$ and verification team confirmed that it is well applied in ER calculation.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of HWC. The QA/QC and related procedures are covered by the ISO 9001 Quality Management Procedures of the nitric acid plant and considered appropriate by the verification team. Valid calibration certificates covering the whole monitoring period are available for the used equipment. It was found that the calibrations were carried out for a measuring range comparable with the actual measuring range and that the calibrations confirmed proper functioning of the monitoring equipment. Please refer to section E.7. below for calibration.</p>
Conclusion	<p>The raised CL 06 has been completely resolved.</p> <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p>

Data/Parameter	$V_{i,t,db}$
Data Unit	m ³ gas i/m ³ dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis

Source of data used	Measuring device (NDIR)
Value(s)	8.82x10 ⁻⁵ m ³ N ₂ O gas /Nm ³ dry gas (total average volumetric fraction from 27/08/2016 to 31/08/2017, from the actual data)
Means of verification	<p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. Furthermore, the KFQ verification team performed data checks between trend curves (generated from raw data) and DCS monthly sheet. Furthermore, the verification team checked the monthly data sheet from ABB data logging system, QAL2 & 3 results and the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p>
Findings	<p>The NDIR analyzer of the tail gas supplied by ABB is used for monitoring this parameter. The sample tube is located in the stack at the end of the tail gas line, and sample gas was leaded to the analyzer house where the analyzer was installed. The location has been confirmed by physical inspection during the on-site visit.</p> <p>It was found that every second data from a NDIR is transferred to the ABB data logging system and hourly average concentration of N₂O is automatically generated. The verification team could check the hourly average N₂O concentration in the monthly data sheet and the N₂O concentration on the monthly data sheet was consistency with the data in the ER calculation sheet. Thus, the verification team concluded all data is reliable and consistent with cross check sources.</p> <p>However $V_{i,t,db}$ shall be adjusted according to the description of calculation method for $V_{i,t,db}$ in the section D.2. of the MR (version 1.0) but the verification team could not confirm whether this adjustment process is considered in $V_{i,t,db}$ calculation or not. Further to this, incorrect $V_{i,t,db}$ for this monitoring period is provided in MR (Version 1.0). (Refer to Appendix 4 / CL ID 07). Regarding to CL ID 07, PP explained how $V_{i,t,db}$ for this monitoring period was calculated based on minute/hourly data of volumetric fraction of the tail gas. The verification team reviewed data of volumetric fraction of the tail gas and could confirm that there was no period where the N₂O concentration of the tail gas are not available for more than 1/3 of any hour while the plant was in operation.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of HWC. The QA/QC and related procedures are covered by the ISO 9001 Quality Management Procedures of the nitric acid plant and considered appropriate by the verification team. Valid calibration certificates covering the whole monitoring period are available for the used equipment. It was found that the calibrations were carried out for a measuring range comparable with the actual measuring range and that the calibrations confirmed proper functioning of the monitoring equipment. Please refer to section E.7. below for calibration.</p>
Conclusion	<p>The raised CL ID 07 has been completely resolved.</p> <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p>

Data/Parameter	$C_{H_2O,t,db,n}$
Data Unit	mg H ₂ O/m ³ dry gas

Description	Moisture content of the gaseous stream at normal conditions, in time interval t
Source of data used	Measurements according to the USEPA CF42 method 4 – Gravimetric determination of water content
Value(s)	0.0046 kgH ₂ O/m ³ dry gas (AST in 21/10/2015 ~ 22/10/2015) 0.0059 kgH ₂ O/m ³ dry gas (QAL2 in 29/09/2016 ~ 01/10/2016) 0.0017 kgH ₂ O/m ³ dry gas (AST in 27/09/2017 ~ 29/09/2017)
Means of verification	The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by document review.
Findings	<p>As per the PDD, the measurements of moisture content were conducted when the calibrations of the flow meter for the gaseous stream (AST/QAL2) were carried out. Repeated measurements were performed by the qualified, external entity SGS coinciding with AST/QAL2 reference measurements (AST: 21/10/2015 ~ 22/10/2015, QAL2: 29/09/2016~ 01/10/2016, AST: 27/09/2017 ~ 29/09/2017). The repeated measurements were conducted in accordance with USEPA CF42 method 4.</p> <p>However, $C_{H_2O,t,db,n}$ for the period of 27/08/2016 to 28/09/2016 is not provided in MR (Version 1.0) (Refer to Appendix 4 / CL ID 08). After PP submitted revised MR (Version 4.0), PP provided $C_{H_2O,t,db,n}$ for the period of 27/08/2016 to 28/09/2016 as 0.0059 kgH₂O/m³ dry gas in the MR with evidence of it. The verification team checked it with AST report issued on 23/10/2015 and gaseous stream is to be considered as dry according to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)” due to it is lower than 0.05 kg H₂O/m³ dry gas.</p>
Conclusion	<p>The raised CL ID 08 has been completely resolved.</p> <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan & relevant tool by the performing institute (SGS).</p>

E.6.3. Implementation of sampling plan

Means of verification	N/A
Findings	N/A
Conclusion	N/A

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

The validation team confirms that the calibration frequency requirements for measuring instruments comply with ACM0019 (version 2) and the monitoring plan in the registered PDD. Calibration frequency of each instrument was checked through the Instrument specifications. Intervals (measuring frequency, reading frequency and recording frequency) for each instrument are also verified through display panel at on-site and DCS generated reports. It is concluded that instruments were set in accordance with ACM0019 (version 2), the monitoring plan in the registered, the revised PDD and approved temporary deviation (PRC-0922-003) from the registered monitoring plan.

Detailed assessment for instruments is as below.

Data/Parameter	$P_{production,y}$
Data Unit	tHNO ₃
Description	Nitric acid produced in the monitoring period

I.D/ Serial No./ Accuracy level		Flow meter for HNO ₃	
	I.D.	10-FT-512	
	Model No.	J405D802000	CMF200L518N2BIEZZZ
	Manufacturer	Endress + Hauser	EMERSON
	Accuracy level	0.15	0.1
	Period of use	07/07/2015 ~ 28/06/2017 (replaced on 29/06/2017)	29/06/2017 ~ 04/02/2018
Type	Coriolis mass flow meter		
Calibration Entity	FM Tech Co., Ltd.		
Calibration frequency	15 Months		
Previous/latest calibration		Previous flow meter	
	Model No.	J405D802000	
	Date of calibration	06/07/2015	19/09/2016
	validity	05/10/2016	18/12/2017
		Current flow meter	
	Model No.	CMF200L518N2BIEZZZ	
	Date of calibration	01/02/2017	
	validity	30/04/2018	
The applied period of max. permissible error when applicable	N/A		
Means of verification/comments	The KFQ validation team has visually checked the physical existence of the instrument. The KFQ validation team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan as well as instrument specifications including manufacturer recommended frequencies.		
Findings	<u>Flow meter</u> Flow meter's location has been confirmed by physical inspection during on-site visit. It was verified that calibration was carried out within defined frequency as per the specification of each monitoring equipment (previous and current flow meter), and there was no delayed calibration occurred. There was a flow meter change during this monitoring period and a newly installed flow meter is more accurate than previous one. The verification team checked specification of new flow meter provided in the revised PDD based on the details of the flow meter provided by manufacturer. Calibration results were within specified error range, and the calibrations confirmed proper functioning of the monitoring equipment and were valid for the monitoring period.		
	<u>Measuring instrument for HNO₃ concentration</u> For calculation of nitric acid produced and determining HNO ₃ concentration, specific gravity hydrometer and liquid-in-glass thermometer are using in this project activity. Accuracy and calibration frequency of specific gravity hydrometer and liquid-in-glass thermometer are as below.		
	Instrument type	Specific gravity hydrometer	Liquid-in-glass thermometer
	Manufacture	Daekwang Inc.	
	Accuracy	< ± 0.002kg/m ³	<± 1°C
	Calibration frequency	36 months	12 months
	According to the revised PDD (version 14), HWC applied calibration frequency of each measuring instrument as per manufacture's (Daekwang Inc.'s) recommendation with reference to "Enforcement Rule on operation accreditation system of national calibration institutes". During this verification process, it is identified that PP use these instruments produced by specialized manufacturer (Daekwang Inc.) and replaced them within next calibration period. Thus, verification team could conclude that monitoring equipment used for determining HNO ₃ concentration are controlled and valid within this monitoring period.		
	The verification team cross-checked date of replacement by documented purchase history during this monitoring period and concluded that adjustment due to delayed calibration is not needed for this monitoring period. And also by interviewing personnel of manufacture (Daekwang) the verification team could		

	verified that HNO ₃ concentration is determined with properly functioned equipment.
Conclusion	KFQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan in the registered and revised PDD and the applied methodology.

Data/Parameter	h _y		
Data Unit	H		
Description	Number of hours of operation in year y		
I.D/ Serial No.		Flow meter for HNO ₃	
	I.D.	10-FT-512	
	Model No.	J405D802000	CMF200L518N2BIEZZZ
	Manufacturer	Endress + Hauser	EMERSON
	Accuracy level	0.15	0.1
	Period of use	07/07/2015 ~ 28/06/2017 (replaced on 29/06/2017)	29/06/2017 ~ 04/02/2018
Type	Coriolis mass flow meter		
Calibration Entity	FM Tech Co., Ltd.		
Calibration frequency	15 Months		
Previous/latest calibration		Previous flow meter	
	Model No.	J405D802000	
	Date of calibration	06/07/2015	19/09/2016
	validity	05/10/2016	18/12/2017
		Current flow meter	
		CMF200L518N2BIEZZZ	
		01/02/2017	
		30/04/2018	
The applied period of max. permissible error when applicable	N/A		
Means of verification/comments	The KFQ validation team has visually checked the physical existence of the instrument. The KFQ validation team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan as well as instrument specifications including manufacturer recommended frequencies.		
Findings	Flow meter's location has been confirmed by physical inspection during on-site visit. The verification team could see that calibration was carried out within defined frequency as per the specification of each monitoring equipment (previous and current flow meter), and there was no delayed calibration occurred. Also calibration results were within specified error range, and the calibrations confirmed proper functioning of the monitoring equipment and were valid for the monitoring period.		
Conclusion	KFQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan and the applied methodology.		

Data/Parameter	V_{t,db}		
Data Unit	m ³ dry gas/h		
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis		
Type	Differential pressure transmitter		
I.D/ Serial No. / Accuracy level	I.D.	10-FT-562	
	Instrument No.	1 st equipment	2 nd equipment
	Serial No.	0553 05121501010	1257760 0712 07030214002
	Manufacturer	Honeywell	Durag Honeywell
	Accuracy level	± 0.075%	< 2% of measuring ± 0.075%

			range																													
	Period of use	29/12/2015 ~ 19/09/2016 (retired on 20/09/2016)	20/09/2016 ~ present	Spare (Not used after 2014)																												
Calibration Entity	SGS (QAL2/AST)																															
Calibration frequency	For serial No. 0553 05121501010: 15 months For serial No. 1257760: 36 months for QAL2 / 12 months for AST																															
Previous/latest calibration	<table border="1"> <tr> <td>I.D.</td><td colspan="3">10-FT-562</td></tr> <tr> <td>Instrument No.</td><td colspan="3">1st equipment</td></tr> <tr> <td>Serial No.</td><td colspan="2">0553 05121501010</td><td>1257760</td></tr> <tr> <td>Date of calibration</td><td>15/01/2015 ~ 16/01/2015 (AST)</td><td>21/10/2015 ~ 22/10/2015 (AST)</td><td>29/09/2016 ~ 01/10/2016 (QAL2)</td></tr> <tr> <td>validity</td><td>14/01/2016</td><td>20/10/2016</td><td>28/09/2019</td></tr> </table>				I.D.	10-FT-562			Instrument No.	1 st equipment			Serial No.	0553 05121501010		1257760	Date of calibration	15/01/2015 ~ 16/01/2015 (AST)	21/10/2015 ~ 22/10/2015 (AST)	29/09/2016 ~ 01/10/2016 (QAL2)	validity	14/01/2016	20/10/2016	28/09/2019								
I.D.	10-FT-562																															
Instrument No.	1 st equipment																															
Serial No.	0553 05121501010		1257760																													
Date of calibration	15/01/2015 ~ 16/01/2015 (AST)	21/10/2015 ~ 22/10/2015 (AST)	29/09/2016 ~ 01/10/2016 (QAL2)																													
validity	14/01/2016	20/10/2016	28/09/2019																													
The applied period of max. permissible error when applicable	N/A																															
Means of verification/comments	The KFQ verification team has visually checked the physical existence of the instrument. The KFQ verification team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan as well as instrument specifications including EN 14181 required frequencies.																															
Findings	<p>It was found that the calibrations were carried out for a measuring range comparable with the actual measuring range and that the calibrations confirmed proper functioning of the monitoring equipment. In addition, as for QAL1, temporary deviation from the registered monitoring plan approved by EB (PRC-0922-003) is applied from 27/08/2016 to 20/09/2016 (date of installation) during this monitoring period. And the verification team checked QAL1 certification of new flow meter at the installation phase.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of HWC. QA/QC is covered by EN 14181, especially QAL2 and AST reference measurements were performed by SGS as below:</p> <table border="1"> <tr> <th colspan="4">History of QAL2 and AST regarding 12th monitoring period</th></tr> <tr> <th>Period measurement</th><th>Type of test</th><th>Validity</th><th>Calibration frequency</th></tr> <tr> <td>13/01/2014~15/01/2014</td><td>QAL2</td><td>12/01/2017</td><td>3 years</td></tr> <tr> <td>21/10/2015~22/10/2015</td><td>AST</td><td>20/10/2016</td><td>12 months</td></tr> <tr> <td>29/09/2016~01/10/2016</td><td>QAL2</td><td>28/09/2019</td><td>3 years</td></tr> <tr> <td>27/09/2017~29/09/2017</td><td>AST</td><td>26/09/2018</td><td>12 months</td></tr> </table> <p>Valid calibration covering the whole monitoring period is available for the used equipment. However, it is found that PP applied correction factor for $V_{t,db}$ derived from QAL2 test result performed on 29/09/2016 for this monitoring period from 27/08/2016. (Refer to Appendix 4 / CL ID 06). PP recalculated $V_{t,db}$ by applying the correction factors from QAL2 test result performed on 13/01/2014~14/01/2014 for the period from 27/08/2016 ~ 28/09/2016. The verification team cross-checked the value with the QAL 2 audit report (13/01/2014~15/01/2014, 29/09/2016~01/10/2016). The verification team confirms that it is found that are no deviation between the MR and the relevant evidence.</p> <p>The correction factor out of the calibration curve determined during the QAL 2 reference measurement (calibration) has been correctly applied on an hourly basis in the emission reduction spreadsheet regarding the calibration date as below:</p> <table border="1"> <tr> <th>Period</th><th>Applied correction factor of $V_{t,db}$</th></tr> <tr> <td>27/08/2016~ 28/09/2016</td><td>$1.036 \times \text{flow} [\text{m}^3/\text{h}] + 0.00$</td></tr> </table>				History of QAL2 and AST regarding 12 th monitoring period				Period measurement	Type of test	Validity	Calibration frequency	13/01/2014~15/01/2014	QAL2	12/01/2017	3 years	21/10/2015~22/10/2015	AST	20/10/2016	12 months	29/09/2016~01/10/2016	QAL2	28/09/2019	3 years	27/09/2017~29/09/2017	AST	26/09/2018	12 months	Period	Applied correction factor of $V_{t,db}$	27/08/2016~ 28/09/2016	$1.036 \times \text{flow} [\text{m}^3/\text{h}] + 0.00$
History of QAL2 and AST regarding 12 th monitoring period																																
Period measurement	Type of test	Validity	Calibration frequency																													
13/01/2014~15/01/2014	QAL2	12/01/2017	3 years																													
21/10/2015~22/10/2015	AST	20/10/2016	12 months																													
29/09/2016~01/10/2016	QAL2	28/09/2019	3 years																													
27/09/2017~29/09/2017	AST	26/09/2018	12 months																													
Period	Applied correction factor of $V_{t,db}$																															
27/08/2016~ 28/09/2016	$1.036 \times \text{flow} [\text{m}^3/\text{h}] + 0.00$																															

	29/09/2016 ~ 31/08/2017	1.052xflow[m ³ /h]+0.00																		
	<p>Thus the result of QAL1, QAL2 and AST tests ensures that the flowmeter for monitoring the N₂O emission complies with the demands stated in the EN 14181. Therefore, it is considered that the flowmeter meets the requirement of European standards and norms (EN 14181) based on the review of provision on 'H.2' of EN 14181¹ and '6.2.1 in Technical Report on Guidance on the application of EN 14181². Thus, it could be confirmed that the flowmeter of 'V_{t,db}' has been properly operated and maintained through the calibration reports of QAL2 and AST, and the correction factors derived from the calibration curve of the QAL2 audit is applied for the mass flow of the tail gas.</p> <p>It was found that differential pressure transmitter was changed with new one of different model on 20 September 2016. The verification team checked that the instrument, as stated in the MR, physically exists and could be identified by the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. It was found, that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p>																			
Conclusion	<p>The raised CL ID 06 has been completely resolved.</p> <p>KFQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan and the applied methodology.</p>																			
Type	Absolute Pressure Transmitter																			
I.D/ Serial No.	<table border="1"> <tr> <td>I.D.</td><td colspan="2">10-PT-362</td></tr> <tr> <td>Instrument No.</td><td>1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td>0712 07030214003</td><td>9853 00002001004</td></tr> <tr> <td>Manufacturer</td><td colspan="2">Honeywell</td></tr> <tr> <td>Accuracy level</td><td colspan="2">± 0.075%</td></tr> <tr> <td>Period of use</td><td>07/02/2017 ~ present</td><td>29/12/2015 ~ 07/02/2017</td></tr> </table>		I.D.	10-PT-362		Instrument No.	1 st equipment	2 nd equipment	Serial No.	0712 07030214003	9853 00002001004	Manufacturer	Honeywell		Accuracy level	± 0.075%		Period of use	07/02/2017 ~ present	29/12/2015 ~ 07/02/2017
I.D.	10-PT-362																			
Instrument No.	1 st equipment	2 nd equipment																		
Serial No.	0712 07030214003	9853 00002001004																		
Manufacturer	Honeywell																			
Accuracy level	± 0.075%																			
Period of use	07/02/2017 ~ present	29/12/2015 ~ 07/02/2017																		
Calibration frequency	15 months																			
Previous/latest calibration	<table border="1"> <tr> <td>I.D.</td><td colspan="2">10-PT-362</td></tr> <tr> <td>Instrument No.</td><td>1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td>0553 05121501010</td><td>1257760</td></tr> <tr> <td>Date of calibration</td><td>29/09/2014</td><td>24/01/2017</td></tr> <tr> <td>validity</td><td>28/12/2015</td><td>23/04/2018</td></tr> <tr> <td>Calibration Entity</td><td>HISCO</td><td>Foundation for industry cooperation University of Ulsan</td></tr> </table>		I.D.	10-PT-362		Instrument No.	1 st equipment	2 nd equipment	Serial No.	0553 05121501010	1257760	Date of calibration	29/09/2014	24/01/2017	validity	28/12/2015	23/04/2018	Calibration Entity	HISCO	Foundation for industry cooperation University of Ulsan
I.D.	10-PT-362																			
Instrument No.	1 st equipment	2 nd equipment																		
Serial No.	0553 05121501010	1257760																		
Date of calibration	29/09/2014	24/01/2017																		
validity	28/12/2015	23/04/2018																		
Calibration Entity	HISCO	Foundation for industry cooperation University of Ulsan																		
The applied period of max. permissible error when applicable	N/A																			
Means of verification/comments	The KFQ verification team has visually checked the physical existence of the instrument. The KFQ verification team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan as well as instrument specifications including EN 14181 required frequencies.																			

¹ H.2 Treatment of existing AMS without certification according to EN 15267-3 in EN 14181:2014

² 6.2.1- 'AMS already installed' in Technical report- Guidance on the application of EN 14181, quality assurance of automated measuring systems (TC264 WI 00264094, version completed 21/10/2007)

Findings	<p>It was found that the instrument, as stated in the monitoring report, physically exists and could be identified by the serial number. It was found that the instrument has been calibrated regularly as per the defined requirements. There was a replacement from 2nd to 1st equipment on 07/02/2017 even 2nd equipment is valid until 20/03/2017 and it was checked through reviewing daily working log. It was found, that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity SGS during 13 to 15 January 2014.</p>																											
Conclusion	KFAQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan and the applied methodology.																											
Type	Absolute Pressure Transmitter																											
I.D/ Serial No.	<table border="1"> <tr> <td>I.D.</td><td colspan="3">10-TT-162</td></tr> <tr> <td>Instrument No.</td><td colspan="2">1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td colspan="2">WS-7M423</td><td>WS-7M140</td></tr> <tr> <td>Manufacturer</td><td colspan="3">Wise controls</td></tr> <tr> <td>Accuracy level</td><td colspan="3">± 0.3 %</td></tr> <tr> <td>Period of use</td><td colspan="2">07/02/2017 ~ present</td><td>29/12/2015 ~ 07/02/2017</td></tr> </table>				I.D.	10-TT-162			Instrument No.	1 st equipment		2 nd equipment	Serial No.	WS-7M423		WS-7M140	Manufacturer	Wise controls			Accuracy level	± 0.3 %			Period of use	07/02/2017 ~ present		29/12/2015 ~ 07/02/2017
I.D.	10-TT-162																											
Instrument No.	1 st equipment		2 nd equipment																									
Serial No.	WS-7M423		WS-7M140																									
Manufacturer	Wise controls																											
Accuracy level	± 0.3 %																											
Period of use	07/02/2017 ~ present		29/12/2015 ~ 07/02/2017																									
Calibration Entity	HISCO(18/12/2015), Foundation for industry cooperation University of Ulsan(18/01/2017)																											
Calibration frequency	15 months																											
Previous/latest calibration	<table border="1"> <tr> <td>I.D.</td><td colspan="3">10-TT-162</td></tr> <tr> <td>Instrument No.</td><td colspan="2">1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td colspan="2">WS-7M423</td><td>WS-7M140</td></tr> <tr> <td>Date of calibration</td><td>30/09/2014</td><td>18/01/2017</td><td>18/12/2015</td></tr> <tr> <td>validity</td><td>29/12/2015</td><td>17/04/2018</td><td>17/03/2017</td></tr> <tr> <td>Calibration Entity</td><td>HISCO</td><td>Foundation for industry cooperation University of Ulsan</td><td>HISCO</td></tr> </table>				I.D.	10-TT-162			Instrument No.	1 st equipment		2 nd equipment	Serial No.	WS-7M423		WS-7M140	Date of calibration	30/09/2014	18/01/2017	18/12/2015	validity	29/12/2015	17/04/2018	17/03/2017	Calibration Entity	HISCO	Foundation for industry cooperation University of Ulsan	HISCO
I.D.	10-TT-162																											
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validity	29/12/2015	17/04/2018	17/03/2017																									
Calibration Entity	HISCO	Foundation for industry cooperation University of Ulsan	HISCO																									
The applied period of max. permissible error when applicable	N/A																											
Means of verification/comments	The KFAQ verification team has visually checked the physical existence of the instrument. The KFAQ verification team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan as well as instrument specifications including EN 14181 required frequencies.																											
Findings	<p>It was found that the instrument, as stated in the monitoring report, physically exists and could be identified by the serial number. It was found that the instrument has been calibrated regularly as per the defined requirements. There was a replacement from 2nd to 1st equipment on 07/02/2017 even 2nd equipment is valid until 17/03/2017. It was found, that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity SGS during 13 to 15 January 2014.</p>																											
Conclusion	KFAQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan and the applied methodology.																											

Data/Parameter	$V_{i,t,db}$						
Data Unit	m ³ gas i/m ³ dry gas						
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis						
I.D/ Serial No.	10-AI-062/ 3.346996.7						
Type	NDIR analyzer						
Accuracy level	± 1%						
Calibration Entity	SGS						
Calibration frequency	36 months (EN 14181/QAL 2)						
Previous calibration	13/01/2014~15/01/2014 (validity: 12/01/2017)						
Latest calibration	29/09/2016~01/10/2016 (validity: 28/09/2019)						
The applied period of max. permissible error when applicable	N/A						
Means of verification/comments	The KFQ validation team has visually checked the physical existence of the instrument. The KFQ validation team has checked the calibration records & instrument history against the calibration requirements as per the applied methodology and the monitoring plan including EN 14181 required frequencies.						
Findings	<p>It was found that the instrument, as stated in the MR, physically exists. It was found that the instrument has been calibrated regularly and as per the defined requirements. It was found, that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>The QAL 1 report for N₂O analyzer was checked at the installation phase during the 1st verification and the verification team confirms that the analyzer has not been changed since the operation of DeN₂O unit. The calibration and maintenance routines for the parameter are the responsibility of HWC. QA/QC is covered by EN 14181, especially QAL 2 reference measurements (calibration). And the QAL2 and AST reference measurements were performed by SGS were performed by SGS as described in the above table of '$V_{i,t,db}$'. As for QAL3, the analyzer is self-calibrated (zero, span) using a set of certified calibration gases in accordance with EN 14181.</p> <p>However, it was found that reported last calibration information regarding QAL 3 is 28/06/2017 in MR (version 1.0) for this monitoring period but it is not consistent with QAL 3 test record. Also according to MR (version 1.0) AST has to be regularly performed once every 12 months. Validity of last calibration of AST is until 14/01/2016 and there was no further information of the next calibration. So it is not fully explained that during the monitoring period N₂O flow and concentrations had been suitably measured with QA/QC requirement of the registered PDD. Further to this, the verification team found that applied correction factor of $V_{i,t,db}$ ($=1.052 \times N_2O[ppm] + 0.00$) is incorrectly indicated in the MR (version 1). (Refer to Appendix 4 / CL ID 07). PP submitted revised MR (version 4) and PP corrected the figure coincided with calculation in the excel spreadsheet (version 3). PP corrected date of last calibration as 23/08/2017 in the revised MR (version 4) and provided N₂O analyser calibration reports for 2016 and 2017. The verification team reviewed QAL3 test (zero/span test) result and found all are within allowable error and thus no adjustment in raw data was needed. And it was checked that last calibration date is correctly indicated in the revised MR (version 4). PP recalculated $V_{i,t,db}$ by applying the correction factors separately from QAL2 test result. The verification team checked consistency of the $V_{i,t,db}$ compared between revised MR and excel spreadsheet. Also the verification team cross-checked the value with the QAL 2 audit report (13/01/2014~15/01/2014, 29/09/2016~01/10/2016). The verification team confirms that it is found that are no deviation between the MR and the relevant evidence. The correction factor out of the calibration curve determined during the QAL 2 reference measurement (calibration) regarding the calibration date as below:</p> <table border="1"> <thead> <tr> <th>Period</th><th>Applied correction factor of $V_{i,t,db}$</th></tr> </thead> <tbody> <tr> <td>27/08/2016 ~ 28/09/2016</td><td>$0.999 \times N_2O[ppm] + 0.00$</td></tr> <tr> <td>29/09/2016 ~ 31/08/2017</td><td>$1.029 \times N_2O[ppm] + 0.00$</td></tr> </tbody> </table>	Period	Applied correction factor of $V_{i,t,db}$	27/08/2016 ~ 28/09/2016	$0.999 \times N_2O[ppm] + 0.00$	29/09/2016 ~ 31/08/2017	$1.029 \times N_2O[ppm] + 0.00$
Period	Applied correction factor of $V_{i,t,db}$						
27/08/2016 ~ 28/09/2016	$0.999 \times N_2O[ppm] + 0.00$						
29/09/2016 ~ 31/08/2017	$1.029 \times N_2O[ppm] + 0.00$						

	<p>So The verification team confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it.</p> <p>The calibration gases applied were valid in the verifying period and cover the range of measurement. Detailed supplier certificates including information on concentration, accuracy and stability are available. Review for zero/span test result was conducted and found all are within allowable error and thus no adjustment in raw data was needed. So the verification team could conclude that valid calibration covering the whole monitoring period is available for the used equipment.</p> <p>The location of the analyzer house, sample take-off point and sample line to the analyzer house have been confirmed by physical inspection during on-site visit. Also, the verification team confirms the analyzer was properly functioned and controlled during the monitoring period according to the EN14181 standard.</p> <p>It was verified that the calibrations were carried out for a measuring range comparable with the actual measuring range and calibration results were within specified error range. The calibrations confirmed proper functioning of the monitoring equipment and were valid for the monitoring period.</p>
Conclusion	<p>The raised CL ID 07 has been completely resolved.</p> <p>KFQ confirms that the calibration has been conducted as per the calibration frequency requirements and that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan, the applied methodology.</p>

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	<p>The verification team has reviewed data, parameters and calculations with respect to calculation of the baseline GHG emissions and checked them against the requirements out of the applied methodology (ACM0019_Version 02.0), the registered and revised PDD as well as relevant tools applied.</p> <p>The verification team has also assessed the completeness, quality and appropriateness of the data, parameters and calculations. Furthermore, the verification team has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PP have been justified and correctly applied, in line with the requirements.</p> <p>The verification team has further crosschecked – as applicable - any information with other sources available, such as but not limited to production log sheets, meters available in the operators control room or on-site, etc.</p>
Findings	<p>The baseline GHG emissions have been found to be 306,615 tCO₂e for the verification period. A complete set of data for baseline emission calculations covering the monitoring period has been provided to the verification team and reviewed during verification as explained E.6.1 and E.6.2 above. Equation and Formulae in emission reductions spreadsheet were reviewed against the methodology, the monitoring plan of the registered and revised PDD.</p> <p>It was found that all emission factors, GWPs and default values and reference values, as applicable, have been correctly justified, are explicitly mentioned in the MR and have been correctly applied. It was found that no assumptions are used that have any relevant influence on reported emission reductions.</p> <p>It was found that all parameters and data except for HNO₃ concentration are automatically collected by the ABB data logging system and DCS system. It was found that there is no uncertainty related to manual transfer of data used in the calculation of emission reduction since the monitored parameters are automatically collected by the ABB data logging system and DCS system. All actions performed at the computer station are logged and the log file is available for the verification.</p>

	<p>There were no errors in the digital transfer of data from ABB data logging and DCS files to the excel spreadsheets for the calculation of emissions reductions.</p> <p>For the HNO₃ concentration, it measures daily by competent HWC internal human resource according to the HWC internal regulation and record on analysis report. Verification team checked analysis report for this monitoring period and crosschecked it with ER calculation spreadsheet to confirm its consistency. No inconsistency identified and it is well reflected in ER calculation.</p> <p>All formulae have been correctly implemented and are accessible and traceable. Any recalculations are in line with the procedure in the registered and revised PDD and have been checked and found to be correct and conservative. Safeguarding procedures in accordance to the monitoring plan have been applied in a conservative way. Rounding of digits, where applicable, has been applied both correctly and conservatively.</p> <p>All necessary documentation is collected, referenced and aggregated and is easily accessible in spreadsheets and daily reports in electronic format. Measurements are performed by calibrated equipment, and key data could be cross-checked via other sources (if applicable), such as raw data generated in the DCS, production log sheets and meters available in the operators control room or on-site. Further details on cross-checks for each parameter and the information flow are given in sections E.6.2 above.</p> <p>A detailed assessment of all relevant parameters for the verification period is given in E.6.1 and E.6.2 above.</p>
Conclusion	<p>KFQ confirms that all required data for calculation of the baseline GHG emissions were available for the whole verification period.</p> <p>KFQ confirms that suitable cross-checking of data was possible and has been performed as described.</p> <p>KFQ confirms that the PP has followed appropriate methods and formulae for calculating baseline GHG emissions have been followed.</p> <p>KFQ confirms that any emission factors, GWPs and default values and reference values – as applicable – that were applied in the calculation have been justified and correctly applied. No assumptions were used.</p> <p>KFQ confirms that the calculation of the baseline GHG emissions for the covered monitoring period is fully complete and based on suitable and verifiable evidence.</p> <p>KFQ finally confirms that the amount of Baseline GHG emissions for the verification period from 27/08/2016 to 31/08/2017, amounting to 306,615 tCO₂e, is correctly determined and calculated.</p>

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

Means of verification	<p>The verification team has reviewed data, parameters and calculations with respect to calculation of the baseline GHG emissions and checked them against the requirements out of the applied methodology (ACM0019_Version 02.0), the registered and revised PDD as well as relevant tools applied.</p> <p>The verification team has also assessed the completeness, quality and appropriateness of the data, parameters and calculations. Furthermore, the verification team has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PP have been justified and correctly applied, in line with the requirements.</p> <p>The verification team has further crosschecked – as applicable - any information with other sources available, such as but not limited to production log sheets, meters available in the operators control room or on-site, etc.</p>
Findings	<p>The project GHG emissions have been found to be 19,248 tCO₂e for the verification period. A complete set of data for project emission calculations covering the monitoring period has been provided to the verification team and reviewed during verification as explained E.6.1 and E.6.2 above. Equation and Formulae in emission reductions spreadsheet were reviewed against the methodology, the monitoring plan of the registered and revised PDD.</p>

	<p>It was found that all emission factors, GWPs and default values and reference values, as applicable, have been correctly justified, are explicitly mentioned in the MR and have been correctly applied. It was found that no assumptions are used that have any relevant influence on reported emission reductions.</p> <p>It was found that all parameters are automatically collected by the ABB data logging system and DCS system. It was found that there is no uncertainty related to manual transfer of data used in the calculation of emission reduction since the monitored parameters are automatically collected by the ABB data logging system and DCS system. All actions performed at the computer station are logged and the log file is available for the verification. There were no errors in the digital transfer of data from ABB data logging and DCS files to the excel spreadsheets for the calculation of emissions reductions.</p> <p>It was found that the spreadsheets, including corresponding re-calculations of data during events as described in the MR, were made available completely by the PP and that all formulae have been correctly implemented and are accessible and traceable. Any recalculations are in line with the procedure in the registered and revised PDD and have been checked and found to be correct and conservative. Safeguarding procedures in accordance to the monitoring plan have been applied in a conservative way. Rounding of digits, where applicable, has been applied both correctly and conservatively.</p> <p>All necessary documentation is collected, referenced and aggregated and is easily accessible in spreadsheets and daily reports in electronic format. Measurements are performed by calibrated equipment, and key data could be cross-checked via other sources (if applicable), such as raw data generated in the DCS, production log sheets and meters available in the operators control room or on-site. Further details on cross-checks for each parameter and the information flow are given in sections E.6.2 above.</p> <p>A detailed assessment of all relevant parameters for the verification period is given in E.6.1 and E.6.2 above.</p>
Conclusion	<p>KFQ confirms that all required data for calculation of the project GHG emissions were available for the whole verification period.</p> <p>KFQ confirms that suitable cross-checking of data was possible and has been performed as described.</p> <p>KFQ confirms that the PP have followed appropriate methods and formulae for calculating project GHG emissions have been followed.</p> <p>KFQ confirms that any emission factors, GWPs and default values and reference values– as applicable – that were applied in the calculation have been justified and correctly applied. No assumptions were used.</p> <p>KFQ confirms that the calculation of the project GHG emissions for the covered monitoring period is fully complete and based on suitable and verifiable evidence.</p> <p>KFQ finally confirms that the amount of Project GHG emissions for the verification period from 27/08/2016 to 31/08/2017, amounting to 19,248 tCO₂e, is correctly determined and calculated.</p>

E.8.3. Calculation of leakage GHG emissions

Means of verification	The verification team has checked, whether leakage emissions (if any) were determined by the PP in accordance with the applied methodology and the PDD.
Findings	The verification team has found that the approach applied by the PP that leakage emissions need not to be considered (i.e. being considered zero, consequently) is in accordance to the applied methodology ACM0019 (Version 2)
Conclusion	The verification team confirms that the PP approach with regard to leakage GHG emissions is correct and that no leakage GHG emissions need to be considered in the project activity based on the applied methodology.

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

Means of verification	The verification team has reviewed data, parameters and calculations with respect to calculation of the GHG emission reductions and checked them against the
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	<p>requirements out of the applied methodology (ACM0019_Version 02.0), the registered and revised PDD as well as relevant tools applied.</p> <p>The verification team has also assessed the completeness, quality and appropriateness of the data, parameters and calculations. Furthermore, the verification team has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PP have been justified and correctly applied, in line with the requirements.</p> <p>The verification team has further crosschecked – as applicable - any information with other sources available, such as but not limited to production log sheets, meters available in the operators control room or on-site, etc.</p> <p>Means of verification in respect of baseline GHG emissions, project GHG emissions and leakage GHG emissions that form the basis for calculation of the GHG emission reductions are stated in detail in sections E.8.1., E.8.2. and E.8.3. above.</p>
Findings	<p>The GHG emission reductions have been found to be 287,367 tCO_{2e} for the verification period. It was found that the first day on which CERs are being claimed in this verification period has been correctly specified by the PP, being 27/08/2016. It was found that a complete set of data covering the monitoring period has been provided by the PP.</p> <p>It was found that all emission factors, GWPs and default values and reference values, as applicable, have been correctly justified, are explicitly mentioned in the MR and have been correctly applied. It was found that no assumptions are used that have any relevant influence on reported emission reductions.</p> <p>It was found that all parameters and data except for HNO₃ concentration are automatically collected by the ABB data logging system and DCS system. It was found that there is no uncertainty related to manual transfer of data used in the calculation of emission reduction since the monitored parameters are automatically collected by the ABB data logging system and DCS system. All actions performed at the computer station are logged and the log file is available for the verification. There were no errors in the digital transfer of data from ABB data logging and DCS files to the excel spreadsheets for the calculation of emissions reductions.</p> <p>For the HNO₃ concentration, it measures daily by competent HWC internal human resource according to the HWC internal regulation and record on analysis report. Verification team checked analysis report for this monitoring period and crosschecked it with ER calculation spreadsheet to confirm its consistency. No inconsistency identified and it is well reflected in ER calculation.</p> <p>It was found that the spreadsheets, including corresponding re-calculations of data during events as described in the MR, were made available completely by the PP and that all formulae have been correctly implemented and are accessible and traceable. Any recalculations are in line with the procedure in the registered PDD and have been checked and found to be correct and conservative. Safeguarding procedures in accordance to the monitoring plan have been applied in a conservative way. Rounding of digits, where applicable, has been applied both correctly and conservatively.</p> <p>All necessary documentation is collected, referenced and aggregated and is easily accessible in spreadsheets and daily reports in electronic format. Measurements are performed by calibrated equipment, and key data could be cross-checked via other sources (if applicable), such as raw data generated in the DCS, production log sheets and meters available in the operators control room or on-site. Further details on cross-checks for each parameter and the information flow are given in sections E.6.2 above.</p> <p>A detailed assessment of all relevant parameters for the verification period is given in E.6.1 and E.6.2 above.</p>
Conclusion	<p>KFQ confirms that all required data for the calculation of GHG emission reductions were available for the whole verification period.</p> <p>KFQ confirms that suitable cross-checking of data was possible and has been performed as described.</p>

	<p>KFQ confirms that the PP have followed appropriate methods and formulae for calculating GHG emission reductions have been followed.</p> <p>KFQ confirms that any emission factors, GWPs and default values and reference values– as applicable – that were applied in the calculation have been justified and correctly applied. No assumptions were used.</p> <p>KFQ confirms that the calculation of the GHG emissions for the covered monitoring period is fully complete and based on suitable and verifiable evidence.</p> <p>KFQ confirms that the first day in which CERs are being claimed in the verification period is 27/08/2016, i.e. later than 31/12/2012.</p> <p>KFQ finally confirms, that the amount of emission reductions claimed by the PP for the verification period from 27/08/2016 to 31/08/2017, amounting to 287,367 tCO₂e, is correctly determined and calculated.</p>
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E.8.5. Comparison of actual GHG emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Means of verification	The verification team compared the ex-ante estimation of emission reductions in the registered PDD with the emission reductions reported by the PP in the monitoring report.
Findings	<p>It is identified that figure of emission reduction achieved during this monitoring period and ex-ante estimated emission reduction is not correctly described in the section E.5. of the MR (version 1.0). (Refer to Appendix 4 / CL ID 09). After PP submitted revised MR (version 4), the verification team confirms that the figures of emission reduction achieved and ex-ante estimation written in the section E.5. of the MR (version 4) are consistent with calculation in the section E.4. and other sections of the MR (version 4).</p> <p>Ex-ante estimation of emission reduction in the registered PDD is 246,432 tonnes of CO₂ equivalents during the 370 days of the monitoring period, from 27/08/2016 to 31/08/2017. Actual emission reductions reported by the PP during this monitoring period is 287,367 tCO₂e which is higher than the value estimated in the registered and revised PDD.</p> <p>The main reasons of the increased emission reductions is due to optimization of nitric acid production plant such as N₂O removal efficiency improvement. Verification team checked it through interview with plant staff and record of HNO₃ production. A detailed assessment of the reasons is given in E.8.6. below.</p> <p>It was found that the PP has correctly described the situation in the MR as well.</p>
Conclusion	<p>The raised CL 09 has been completely resolved.</p> <p>KFQ confirms that the overall emission reductions of the project activity were clearly over the ex-ante estimation in the PDD.</p> <p>KFQ confirms the reported emission reductions in the MR (version 4) increased around 17 % compared to the ex-ante estimation of emission reductions in the PDD.</p>

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

Means of verification	As per the specific instructions of the CDM-VCR-FORM, in this section it is to be explained how the cause of any increase in the actual GHG emission reductions in this monitoring period were assessed in accordance with the applicable verification requirements in the VVS.
Findings	<p>The reported emission reductions in the MR (version 4) increased around 17% compare to the ex-ante estimation of emission reductions in the PDD. In details, reported baseline emission is increased around 11 % and reported project emission is decreased around 38% compare to the ex-ante estimation of emission reduction in the PDD for this monitoring period.</p> <p>The main reasons of the increased emission reductions is due to optimization of nitric acid production plant such as N₂O removal efficiency improvement. Verification team checked it through interview with plant staff and record of HNO₃ production. As a result of this optimization, HNO₃ production has been increased by 12 % compared to ex-ante estimation of it thus actual emission reductions are also</p>

	increased around 17% of ex-ante estimated emission reductions in the PDD. The verification team checked it through interview with plant staff and record of HNO ₃ production. Also verification team confirms that reason for increase of actual emission reductions is reliable and well reflected in the MR.
Conclusion	KFQ confirms the reason for increase of actual emission reductions compared to the ex-ante estimation in the registered PDD is valid and thus, the actual emission reduction is deemed reliable.

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 GHG emission reductions reported in the MR are 287,367 tCO ₂ e. As described in detail in <i>Section E</i> of this report, all relevant aspects of the project activity have been assessed in order to determine, whether the claimed emission reductions by the PP are correctly determined, reasonable and fairly stated and based on verifiable evidence and in accordance with the applied methodology and the registered and revised PDD as well as applicable tools.
Findings	It was found that the project activity is implemented and operated according to the registered and revised PDD and the monitoring of any and all data and parameters as well as calculation of baseline GHG emissions, project GHG emissions and GHG emission reductions is completely conducted in accordance with the registered and revised PDD, the applied methodology and applicable tools.
Conclusion	The verification team confirms that the GHG emission reduction reported in the MR and claimed by the PP are correctly determined with 287,367 tCO ₂ e for the covered monitoring period between 27/08/2016 to 31/08/2017. This implies that 100% of the reported GHG emission reduction in the monitoring period has been achieved in a period after the end of 31/12/2012, i.e. the 1 st commitment period is untouched by this verification period.

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

Means of verification	The PP has neither developed sustainable development co-benefits nor monitored sustainable development co-benefits of the project activity, the section is therefore not applicable in this verification period.
Findings	N/A
Conclusion	N/A

E.10. Global stakeholder consultation

Means of verification	There were no comments received with regard to the stakeholder consultation conducted after the publication of the first monitoring report in accordance with the “CDM project cycle procedure for project activities”, the section is therefore not applicable in this verification period.
Findings	N/A
Conclusion	N/A

SECTION F. Internal quality control

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

SECTION G. Verification opinion

Through the verification for the monitoring report of the CDM project activity: “Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea” in accordance with VVS (version 2.0), KFQ could confirm that:

- The project activity has been implemented and operated as per the registered PDD (Version 13, dated 24/06/2016) and revised PDD (Version 14, dated 20/12/2018).
- The installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately.
- The monitoring plan in the registered PDD and revised PDD is as per the applied methodology,
- The monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan, and approved methodology including applicable tool(s) and generated GHG emission reductions data.
- The GHG emission reductions in the MR (Version 4) are calculated without material misstatements.

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

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

Project Title	Catalytic N ₂ O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea
UNFCCC Reference Number	0922
Date of registration	03/05/2007
PDD (2 nd crediting period)	Version 13 of 24/06/2016 (registered) Version 14 of 20/12/2018 (revised)
Methodology applied	ACM0019 (Version 2)
The latest version of Monitoring Report	4 (dated 02/01/2019)
Crediting period	27/06/2014 to 26/06/2021 (2 nd crediting period)
Monitoring period	27/08/2016 to 31/08/2017 (370 days)
Total GHG emission Reductions Verified	Baseline emissions: 306,615 tonnes CO _{2e} Project emissions: 19,248 tonnes CO _{2e} Leakage: 0 tonnes CO _{2e} Emission reductions: <u>287,367 tonnes CO_{2e}</u>

It is the opinion of KFQ that the amount of GHG emission reductions achieved by the project activity during this monitoring period is correct and that complies with all applicable CDM requirements.

SECTION H. Certification statement

Korean Foundation for Quality has performed the periodic verification of the emission reductions that have been reported for the CDM project activity: "Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea" (UNFCCC Registration Ref. No. 0922) for the period from 27/08/2016 to 31/08/2017.

The project participants are responsible for the collection of data in accordance with the monitoring plan in the registered PDD and the reporting of GHG emissions reductions from the project. It is KFQ's responsibility to express an independent verification statement on the reported GHG emission reductions from the project.

KFQ conducted the verification on the basis of the monitoring methodology ACM0019 (ver. 2), the registered PDD (version 13 as of 24/06/2016), the revised PDD (version 14 as of 20/12/2018), the validation opinion-crediting period renewal (dated 12/02/2014, rev.01) and the latest MR (version 4 dated on 02/01/2019).

KFQ's verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. KFQ planned and performed the verification by obtaining evidence and other information and explanations that KFQ considers necessary to give reasonable assurance on the reported GHG emission reductions.

In our opinion, the GHG emissions reductions of the "Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea" (UNFCCC Registration Ref. No. 0922) for the period from 27/08/2016 to 31/08/2017 are fairly stated in the MR (version 04).

The data generation, aggregation, recording, calculation and reporting of GHG emission reductions were correctly conducted on the basis of the approved baseline and monitoring methodology ACM0019 (ver. 2) and the monitoring plan in the registered PDD and revised PDD.

Hence, KFQ is able to certify that the emission reductions of the "Catalytic N₂O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Hanwha Corporation (HWC) in Ulsan, Republic of Korea" during the period from 27/08/2016 to 31/08/2017 are 287,367 tons of CO₂ equivalent.

Signed on behalf of the Korean Foundation for Quality

Signature : 

Name : Soon Hong YEOM, Managing Director

Date : 03 January 2019

Appendix 1. Abbreviations

Abbreviations	Full texts
ACM	Approved consolidated methodology
AMS	Automated Measuring System
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction(s)
CL	Clarification Request
CMP	COP/MOP Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DOE	Designated Operational Entity
DCS	Distributed Control System
EB	Executive Board
ER	Emission Reductions
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
HWC	Hanwha Corporation
IPCC	Intergovernmental Panel on Climate Change
KFQ	Korean Foundation for Quality
MP	Monitoring Plan
MR	Monitoring Report
N ₂ O	Nitrous oxide
NDIR	Non-dispersion infrared absorption analyzer
PDD	Project Design Document
PP	Project Participant
PRC	Post-registration change
PS	Clean Development Mechanism Project Standard
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Clean Development Mechanism Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers



CERTIFICATE OF COMPETENCE

Name: Mi Jung LEE

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

- 1.1 Thermal energy generation
- 1.2 Renewables
- 3.1 Energy demand
- 5.2 Caprolactam, nitric and adipic acid
- 11.1 Emission of Fluorinated gases
- 11.2 Refrigerant gas production
- 13.1 Solid waste and wastewater
- 13.2 Manure

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 14 September 2017.

Sustainability Management Institute
Yu Shim JEONG



CERTIFICATE OF COMPETENCE

Name: Yu Shim JEONG

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

- 1.2 Renewables
- 5.1 Chemical Industry
- 5.2 Caprolactam, nitric acid, adipic acid
- 11.1 Emission of Fluorinated gases
- 11.2 Refrigerant gas production

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 16 May 2016

Sustainability Management Institute
Sang Yeon PARK



CERTIFICATE OF COMPETENCE

Name: Su Hyun PARK

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

1.2 Renewables

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 11 January 2018

Sustainability Management Institute
Mi Jung LEE

CERTIFICATE OF COMPETENCE

Name: Sung Han YOON

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

- 1.1 Thermal energy generation
- 1.2 Renewables
- 5.1 Chemical Industry
- 5.2 Caprolactam, nitric and adipic acid
- 11.1 Emissions of fluorinated gases
- 11.2 Refrigerant gas production
- 13.1 Solid waste and wastewater
- 13.2 Manure

He is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 16 May 2016.

Sustainability Management Institute
Sang Yeon PARK



Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
1	Project participants	Monitoring report :	Ver. 1 (27/03/2018) Ver. 4 (02/01/2019)	Project participant
2	Project participants	Calculation spreadsheet of emission reductions • Hanwha_12 th CERs_20160827_20170831	Ver. 1 (21/03/2018) Ver. 3 (20/12/2018)	Project participant
3	Project participants	CDM Project Design Document : 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:0922) • Registered PDD	Ver.13 (24/06/2016) http://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/view	Others
4	Project participants	CDM Project Design Document : 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:0922) • Revised PDD	Ver.14 (20/12/2018)	Others
5	TÜV SÜD Industrie Service GmbH	CDM Validation Report: Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:0922). (08/02/2007)	http://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/view?cp=1	Others
6	DNV	CDM Validation Opinion (Renewal): 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:0922) Report No. 2014-9033 (12/02/2014)	http://cdm.unfccc.int/Projects/DB/TUEV-SUED1341912725.05/view	Others
7	KFQ	Validation report(Post-registration changes): 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:PRC-0922-001)	(23/12/2015) http://cdm.unfccc.int/filestorage/O/K/L/OKLVMQDF70GTUYR5Z4A86XPC1SJ23E/VR%20for%20PRC_HWC_v.1.0_20151223_confirmed.pdf?t=Q2x8cGp2YzUyDAwltsc99kulbPapkBF1Fm	Others
8	KFQ	Validation report(Post-registration changes): 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:PRC-0922-002)	(06/07/2016) http://cdm.unfccc.int/filestorage/9/R/S/9RSYO8M56Q2V1NJCZ4P3LWX7HG0UTD/VR%20for%20PRC_HWC_v.1_confirmed.pdf?t=Q3N8cGp2Yzk4fDAZbXRIaahUNgNdbIWAANm	Others
9	KFQ	Validation report(Post-registration changes): 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan (Ref. No.:PRC-0922-003)	(22/05/2017) http://cdm.unfccc.int/filestorage/X/9/K/X9KVH6Q5YCITULSG4AFBJOM378D0W2/VR%20for%20PRC_HWC_v.1.0_20170522.pdf?t=Y098c	Others

			Gp2YzcfDASGdMagO vnli0bto80qma5	
10	KFQ	Validation report(Post-registration changes): 'Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan	(02/01/2019)	Others
11	KFQ	CDM Verification Report Catalytic N ₂ O Abatement project in the tail gas of the nitric acid plant of the HWC in Ulsan-11 th monitoring, Report ver. 2 (19/07/2017)	http://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/view	other
12	Hanwha Corporation	Construction completion report of switching location of DeN ₂ O unit	29/11/2016	Project participant
13	Hanwha Corporation	CDM Monitoring Manual of HWC	December 2018	Project participant
14	Hanwha Corporation	Daily operation report (excel files, pdf files) - ABB logging file - DCS	27/08/2017 ~ 31/08/2018	Project participant
		Event log files		
		Summary shutdowns & observations		
15	Hanwha Corporation	Daily working log	20/09/2016 22/09/2016 07/02/2017 29/06/2017 05/02/2018	Project participant
16	Endress+ Hauser	Manual on Mass flow meter (Proline Promass 801, Endress+ Hauser)	May 2010	Project participant
17	EMERSON	Product Data Sheet (Specifications of HNO ₃ flow meter)	PS-00374, Rev. AC (November 2015)	Project participants
18	HWC	Purchasing inquiry of HNO ₃ flow meter (EMERSON)	05/09/2016, 03/01/2017	Project participants
19	FMTech	Flow meter of HNO ₃ production - Calibration result on flow meter (FT-512)	06/07/2015 19/09/2016 01/02/2017	Project participant
20	Hanwha Corporation	Internal standard for testing HNO ₃	HWO-C-101 Version 01 (01/06/2005)	Project participant
21	Hanwha Corporation	Daily analysis sheet of HNO ₃ concentration	27/08/2017 ~ 31/08/2018	Project participant
22	UHDE	Operation manual - Technical standard for determination of HNO ₃ concentration	July 1992	Project participant
23	Ministry of Trade, Industry and Energy	Framework Act on National Standards	13/12/2018	Others
24	Korean Agency for Technology and Standard	Enforcement Rule on operation accreditation system of national calibration institutes	25/10/2016	Others
25	Hanwha Corporation	Purchase record - Statement of transaction of specific gravity hydrometer	23/10/2015 27/05/2016 30/08/2016	Project participant

			12/07/2017 13/04/2018	
26	Hanwha Corporation	Purchase record - Statement of transaction of thermometer	12/06/2015 27/05/2016 08/03/2017 16/02/2018	Project participant
27	Hanwha Corporation	Operation manual of Onsan plant	HWO-A-402 Rev.8 01/06/2018	Project participant
28	Hanwha Corporation	Assessment reports for competence of measurement staff	06/03/2017	Project participant
29	DURAG	Specification on Volume flow measuring system (D-FL100)	https://www.durag.com/products-en/measuring-monitoring-en/volume-flow-measurement-en/d-fl-100-en/	Project participant
30	Foundation for Industry Cooperation University of Ulsan	Flow meter at outlet of DeN ₂ O unit - Calibration result on flow meter (FT-562)	28/12/2015	Project participant
31	HISCO	Flow meter at outlet of DeN ₂ O unit - Calibration result on Pressure Transmitter (PT-362)	29/09/2014 03/12/2015	Project participant
32	Foundation for Industry Cooperation University of Ulsan	Flow meter at outlet of DeN ₂ O unit - Calibration result on Pressure Transmitter (PT-362)	24/01/2017	Project participant
33	HISCO	Flow meter at outlet of DeN ₂ O unit - Calibration result on Temperature Detector (TT-162)	30/09/2014 18/12/2015	Project participant
34	Foundation for Industry Cooperation University of Ulsan	Flow meter at outlet of DeN ₂ O unit - Calibration result on Temperature Detector (TT-162)	18/01/2017	Project participant
35	TUVSUD	QAL1 report of N ₂ O analyser	01/04/2014	Project participant
36	SGS	EN14181 QAL2 N ₂ O and flow measurements at the HWC outlet Nitric acid plant	13/01~15/01/2014 29/09~01/10/2016	Project participant
37	SGS	EN14181 AST Validation N ₂ O measurements at HWC	21/10~22/10/2015 27/09~29/09/2017	Project participant
38	Innotech	Zero & Span test - Calibration report (zero&span test) - N ₂ O analyser weekly check sheet	08/2016~08/2017	Project participant
39	Hanwha Corporation	N ₂ O analyser Calibration report	2016 2017	Project participant
40	Deokyang	Certificate of Analysis on Standard Gas(N ₂ O/N ₂)	29/01/2016 14/11/2016 07/07/2017	Project participant
41	KMAR	ISO 9001:2008 Certificate, valid until 15/12/2017	08/12/2014	Project participant
42	Hanwha Corporation	MoC Annex 2	05/04/2017 https://cdm.unfccc.int/Projects/DB/TUEV-	Project participant

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43	Ministry of Environment	Clean Air Conservation Act of the Republic of Korea	28/01/2017 29/11/2018 http://www.law.go.kr/%EB%B2%95%EB%A0%B9/%EB%8C%80%EA%B8%B0%ED%99%98%EA%B2%BD%EB%B3%B4%EC%A0%84%EB%B2%95	Others
44	Office for Government Policy Coordination	Framework Act on Low Carbon, Green Growth	31/10/2013 http://www.law.go.kr/lsInfoP.do?lsiSeq=142380#0000	Others
45	Ministry of Knowledge, Economy	The confirmation letter from the Ministry of Knowledge and Economy (stated that CDM project facilities do not have any target obligation on GHG emissions from this GHG and Energy Target Scheme)	21/10/2011	Project participant
46	CEN (European committee for Standardization)	EN14181 Stationary source emissions - Quality assurance of automated measuring systems	11/10/ 2014	Others
47	CEN (European committee for Standardization)	TC264 WI 00264094 Stationary source emissions — Technical Report - Guidance on the application of EN 14181, quality assurance of automated measuring systems	21/10/2007	Others
48	CDM Executive Board	Methodology ACM0019 “N ₂ O abatement from nitric acid production” (Version 02) Tool - Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 03.0 Tool - Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion, version 03.0 Standards, Procedures & Checklists <ul style="list-style-type: none"> • Standard – CDM Validation and Verification Standard for project activities (Version 02.0) • Standard – CDM Project Standard for project activities (Version 02.0) • Procedure – CDM project cycle procedure for project activities (Version 02.0) • Guideline – Application of materiality in verifications (Version 02.0) • Form - Monitoring report form (Version 06.0) 	31/03/2013 http://cdm.unfccc.int/methodologies/DB/MNMFNF10VUEOJACEIRX3EHYC9QXGDC 27/11/2015 http://cdm.unfccc.int/Reference/tools/index.html 22/09/2017 http://cdm.unfccc.int/Reference/tools/index.html 29/11/2018 29/11/2018 29/11/2018 20/02/2015 07/06/2017	Others

		<ul style="list-style-type: none">Form - Verification and certification report form for CDM project activities (Version 02.1)	11/01/2018 All published under: http://cdm.unfccc.int/Reference/index.html	
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Appendix 4. Clarification requests, corrective action requests and forward action requests

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

FAR ID	-	Section no.	-	Date: -
Description of FAR				
N/A				
Project participant response				Date: -
N/A				
Documentation provided by project participant				
N/A				
DOE assessment				Date: -
N/A				

Table 2. CL from this verification

CL ID	01	Section no.	E.1.	Date: 25/04/2018
Description of CL				
As per instructions for completing CDM-MR-FORM, PP has to provide information such as the approval dates and reference numbers of PRCs that have been approved by EB. But PP didn't provide the information of approved PRCs (ref. no. PRC-0922-001, PRC-0922-002) in the section B.2. of MR (version 1).				
Project participant response				Date: 02/01/2019
PP submitted revised MR (version 4). PP described all PRCs which are already approved by EB as applicable prior to this monitoring period, from this monitoring period or being submitted with this MR under issuance track in the revised MR (version 4).				
Documentation provided by project participant				
· MR (version 4)				
DOE assessment				Date: 03/01/2019
The verification team verified that all PRCs (ref. no. PRC-0922-001, PRC-0922-002, PRC-0922-003) are completely stated in the revised MR (version 4). So the verification team confirmed that the MR (version 4) is in compliance with the latest monitoring report form (version 6.0) and the instructions therein.				

CL ID	02	Section no.	E.5.	Date: 25/04/2018
Description of CL				
It is identified that version of applied methodology (ACM0019) in MR (version 1) is 3 which is inconsistent with the registered PDD. Further to this, as per the applied methodology ACM0019 (version 2), parameter 'P _{production,y} ' which is production of nitric acid in year y is used for calculation of baseline emissions. But it is found that the parameter is written as 'P _{product,y} ' in section of E.1. of MR (version 1) and also in the registered PDD (version 13).				
Project participant response				Date: 02/01/2019
PP submitted revised MR (version 4) and PDD (version 14).				
Documentation provided by project participant				
· MR (version 4)				
· Revised PDD (version 14)				
DOE assessment				Date: 03/01/2019
After PP submitted revised MR (version 4), it is found that all typographical errors of the version of applied methodology (ACM0019) and parameter, 'P _{production,y} ' are correctly indicated in the MR (version 4) and PDD (version 14).				

CL ID	03	Section no.	E.6.1.	Date: 25/04/2018
Description of CL				
It is identified EF _{default,y} and EF _{new,y} for year 2016 and 2017 are not provided in Section D.1 of the MR (version 1).				
Project participant response				Date: 02/01/2019
PP submitted revised MR (version 4). PP indicated relevant EF _{default,y} and EF _{new,y} for this monitoring period.				
Documentation provided by project participant				

· MR (version 4)	
DOE assessment	Date: 03/01/2019
· The verification team confirms that the parameters have been properly updated according to the registered, revised PDD and it is correctly applied in ER calculation.	

CL ID	04	Section no.	E.6.1.	Date: 25/04/2018
Description of CL				
Figure of $P_{\text{product, max}}$ in the registered PDD is 107,100 t HNO_3 and it is for the 1 year, 365 days. Therefore, it has to be adjusted according to this monitoring period (370 days). However, $P_{\text{product, max}}$ is not adjusted for this monitoring period.				
Project participant response				Date: 02/01/2019
After the PP has submitted the revised MR (version 04), PP re-calculated $P_{\text{product, max}}$ according to the monitoring period (127 days for year 2016 and 243 days for year 2017) as 108,465 t HNO_3 .				
Documentation provided by project participant				
· MR (version 4)				
· ER calculation sheet (version 3)				
DOE assessment				Date: 03/01/2019
After the PP has submitted the revised MR (version 04), PP recalculated $P_{\text{product, max}}$ according to the monitoring period (127 days for year 2016 and 243 days for year 2017) as 108,465 t HNO_3 . And it is well reflected in ER calculation.				

CL ID	05	Section no.	E.6.2.	Date: 25/04/2018
Description of CL				
During on-site inspection, PP did not provide explanation on how HNO_3 concentration is monitoring and reflecting in calculation ' $P_{\text{production, y}}$ '.				
Project participant response				Date: 02/01/2019
PP decided to revise registered monitoring plan to provide clear monitoring plan of ' $P_{\text{production, y}}$ '. PP described the information of monitoring HNO_3 concentration in revised PDD (version 14). Please further details on PRC validation report (version 01.1, 20/12/2018).				
Documentation provided by project participant				
· MR (version 4)				
· Revised PDD (version 14)				
· ER calculation sheet (version 3)				
DOE assessment				Date: 03/01/2019
The verification team confirms that calculation of HNO_3 concentration is well implemented for this monitoring period according to the monitoring plan of revised PDD (version 14).				

CL ID	06	Section no.	E.6.2.	Date: 25/04/2018
Description of CL				
Volumetric flow of the tail gas shall be adjusted according to the description of calculation method for $V_{t, db}$ in the section D.2. of the MR (version 1.0) but the verification team could not confirm that it was considered this adjustment process in $V_{t, db}$ calculation. Further to this, the value of $V_{t, db}$ in MR (Version 1.0) and ER calculation spreadsheet (Version 1.0) are inconsistent.				
Lastly, it is found that PP applied correction factor for $V_{t, db}$ derived from QAL2 test result performed on 29/09/2016 for this monitoring period from 27/08/2016.				
Project participant response				Date: 02/01/2019
PP explained how $V_{t, db}$ for this monitoring period was calculated based on minute/hourly data of volumetric flow of the tail gas. Regarding to the inconsistency of $V_{t, db}$ in MR and ER calculation spreadsheet, PP revised MR (Version 4.0) and ER calculation spreadsheet (Version 3.0) to reflect final calculated $V_{t, db}$ and verification team confirmed that it is well applied in ER calculation.				
And PP recalculated $V_{i, t, db}$ by applying the correction factors separately from QAL2 test result performed on 13/01/2014~14/01/2014 for the period from 27/08/2016 ~ 28/09/2016				
Documentation provided by project participant				

- MR (version 4)
- ER calculation sheet (version 3)
- Data sheet (recording by minute) from ABB data logging system
- Report of EN 14181 QAL 2 Reference measurements (13/01/2014~15/01/2014)

DOE assessment	Date: 03/01/2019
<p>The verification team also reviewed data of volumetric flow of the tail gas and could confirm that there was no period where the volume of the tail gas are not available for more than 1/3 of any hour while the plant was in operation. Regarding to the inconsistency of $V_{t,db}$ in MR and ER calculation spreadsheet, PP revised MR (Version 4.0) and ER calculation spreadsheet (Version 3.0) to reflect final calculated $V_{t,db}$ and verification team confirmed that it is well applied in ER calculation.</p> <p>The verification team cross-checked the value with the QAL 2 audit report (13/01/2014~15/01/2014, 29/09/2016~01/10/2016). The verification team confirms that it is found that are no deviation between the MR and the relevant evidence.</p>	

CL ID	07	Section no.	E.6.2.	Date: 25/04/2018
Description of CL				
<p>$V_{i,t,db}$ shall be adjusted according to the description of calculation method for $V_{i,t,db}$ in the section D.2. of the MR (version 1.0) but the verification team could not confirm whether this adjustment process is considered in $V_{i,t,db}$ calculation or not. Further to this, incorrect $V_{i,t,db}$ for this monitoring period is provided in MR (Version 1.0).</p> <p>it was found that reported last calibration information regarding QAL 3 is 28/06/2017 in MR (version 1.0) for this monitoring period but it is not consistent with QAL 3 test record. Also according to MR (version 1.0) AST has to be regularly performed once every 12 months. Validity of last calibration of AST is until 14/01/2016 and there was no further information of the next calibration. So it is not fully explained that during the monitoring period N_2O flow and concentrations had been suitably measured with QA/QC requirement of the registered PDD. Further to this, the verification team found that applied correction factor of $V_{i,t,db}$ ($=1.052 \times N_2O[ppm] + 0.00$) is incorrectly indicated in the MR (version 1).</p>				
Project participant response				Date: 02/01/2019
<p>PP explained how $V_{i,t,db}$ for this monitoring period was calculated based on minute/hourly data of volumetric fraction of the tail gas.</p> <p>PP submitted revised MR (version 4) and PP corrected the figure coincided with calculation in the excel spreadsheet (version 3). PP corrected date of last calibration as 23/08/2017 in the revised MR (version 4) and provided N_2O analyser calibration reports for 2016 and 2017.</p> <p>PP recalculated $V_{i,t,db}$ by applying the correction factors separately from QAL2 test result.</p>				
Documentation provided by project participant				
<ul style="list-style-type: none">MR (version 4)ER calculation sheet (version 3)N_2O Analyzer Calibration Report (QAL 3 test record on year 2016 and 2017)Data sheet (recording by minute) from ABB data logging systemReport of EN 14181 QAL 2 Reference measurements (13/01/2014~15/01/2014)				
DOE assessment				Date: 03/01/2019
<p>The verification team reviewed data of volumetric fraction of the tail gas and could confirm that there was no period where the N_2O concentration of the tail gas are not available for more than 1/3 of any hour while the plant was in operation.</p> <p>The verification team reviewed QAL3 test (zero/span test) result and found all are within allowable error and thus no adjustment in raw data was needed. And it was checked that last calibration date is correctly indicated in the revised MR (version 4).</p> <p>The verification team checked consistency of the $V_{i,t,db}$ compared between revised MR and excel spreadsheet. Also the verification team cross-checked the value with the QAL 2 audit report (13/01/2014~15/01/2014, 29/09/2016~01/10/2016). The verification team confirms that it is found that are no deviation between the MR and the relevant evidence.</p>				

CL ID	08	Section no.	E.6.2.	Date: 25/04/2018
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Description of CL	
As per the applied tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" version 03.0), PP has to demonstrate that moisture content of the gaseous stream ($C_{H_2O,t,db,n}$) is less or equal to 0.05 kg H_2O/m^3 dry gas. However, $C_{H_2O,t,db,n}$ for the period of 27/08/2016 to 28/09/2016 is not provided in MR (Version 1.0)	
Project participant response	Date: 02/01/2019
PP submitted revised MR (Version 4.0). PP provided $C_{H_2O,t,db,n}$ for the period of 27/08/2016 to 28/09/2016 as 0.0059 kg H_2O/m^3 dry gas in the MR with evidence of it.	
Documentation provided by project participant	
<ul style="list-style-type: none"> MR (version 4) EN14181 AST Validation N_2O measurements at HWC (23/10/2015) 	
DOE assessment	Date: 03/01/2019
The verification team checked it with AST report issued on 23/10/2015 and gaseous stream is to be considered dry as per "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)" due to it is lower than 0.05 kg H_2O/m^3 dry gas.	

CL ID	09	Section no.	E.8.5.	Date: 25/04/2018
Description of CL				
The verification team found that figure of emission reduction achieved during this monitoring period and ex-ante estimated emission reduction is not correctly described in the section E.5. of the MR (version 1.0).				
Project participant response				Date: 02/01/2019
PP submitted revised MR (version 4) and corrected the editorial error in the revised MR.				
Documentation provided by project participant				
<ul style="list-style-type: none"> MR (version 4) 				
DOE assessment				Date: 03/01/2019
The verification team confirms that the figures of emission reduction achieved and ex-ante estimation written in the section E.5. of the MR (version 4) are consistent with calculation in the section E.4. and other sections of the MR (version 4).				

Table 3. CAR from this verification

CAR ID	01	Section no.	E.3.	Date: 25/04/2018
Description of CAR				
It is identified that there were 7 times of shutdown this monitoring period in the MR (version 1) but description and shutdown period of it in ER calculation spreadsheet is inconsistent. Further to this, PP explained that emission reduction for this shut-down is treated as '0' in MR (version 1.0) but it was not reflected in ER calculation.				
Project participant response				Date: 02/01/2019
PP reviewed data from ABB data logging system and DCS system and number of the events were increased to include other abnormal operation such as DCS system failure and non-stationary data recording. Also PP clarified its conservative approach that baseline emissions were regarded as zero for those event periods in the revised MR (Version 4).				
Documentation provided by project participant				
<ul style="list-style-type: none"> MR (version 4) ER calculation sheet (version 4) Monthly data sheet from ABB data logging system and DCS system Daily operation records 				
DOE assessment				Date: 03/01/2019
The verification team verified the description of operational events regarding nitric acid plant and DeN_2O unit is clearly and sufficiently described in the MR (version 4). It was confirmed by KFQ through checking documented shut down reports, the daily operation records, ABB data logging and DCS etc., and also interviewing relevant plant staff of HWC. The verification team verified that baseline emissions of these downtimes are regarded as zero in a conservative manner. KFQ confirms that baseline emissions were regarded as zero for those above mentioned event periods when shutdowns of Nitric acid plant and/or DeN_2O unit due to overhaul, replacement of catalyst and emergency shutdown etc. were occurred. And the verification team confirms that it is clearly and correctly implemented in excel spread sheet.				

Table 4. FAR from this verification

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