



**Verification and certification report form for
CDM project activities
(Version 04.0)**

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

BASIC INFORMATION

Title and UNFCCC reference number of the project activity	<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 		
Scale of the project activity	<input checked="" type="checkbox"/> Large-scale <input type="checkbox"/> Small-scale		
Version number of the verification and certification report	• Version 01.2		
Completion date of the verification and certification report	• 30/09/2021		
Monitoring period number and duration of this monitoring period	<ul style="list-style-type: none"> Monitoring period number: 15th (6th monitoring period in the 2nd crediting period) Duration: 01/01/2020~31/12/2020 		
Version number of the monitoring report to which this report applies	• Version 2.1		
Crediting period of the project activity corresponding to this monitoring period	• From 27/06/2014 to 26/06/2021		
Project participants	• Hanwha Corporation		
Host Party	• 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	• Sectoral scope: 5-Chemical industries		
Conditional sectoral scopes, if applicable	• 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	• Amount estimated in PDD for 2020(366 day): 243,330 tCO ₂ e		
Certified amount of GHG emission reductions or GHG removals for this monitoring period	Amount before 1 January 2013	Amount from 1 January 2013 until 31 December 2020	Amount from 1 January 2021
	-	293,153 tCO ₂ e	-
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	Yu Shim JEONG 		

	Managing Director of Energy-Climate Change Assessment Division
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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 01/01/2020 to 31/12/2020. 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 01/01/2020 to 31/12/2020 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 and 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 participant. 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, On-san eup, Ul-ju 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 14 of 20/12/2018
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	01/01/2020 to 31/12/2020 (366 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 01/01/2020 to 31/12/2020.

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 monitoring plan and its associated documents.

The implementation of the project resulted in 293,153 tCO₂e of emission reductions during the monitoring period from 01/01/2020 to 31/12/2020 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 2.1) are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology ACM0019 (version 02) and monitoring plan in the registered PDD and proposed temporary deviation from the monitoring methodology.

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 01/01/2020 to 31/12/2020 amount to 293,153 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	JANG	Pyung Hee	KFQ	√	√	√	√
2.	Verifier(*)	IR	PARK	Su Hyun	KFQ	√	√	√	√
3.	Trainee	IR	OH	Jae Ryoung	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	CHO	Jin Seok	KFQ
2.	Approver	IR	JEONG	Yu Shim	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.	Number of Monitoring parameters	L	Methodology and tool require a rather low number of monitoring parameters	The KFQ verification team included three verifiers in total and all 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 (ver.01)
2.	Error rate in Monitoring report'	M	Expert organization is involved in compilation of MR as well as calculation	In response of that risk, the KFQ verification team focuses on systematic consistency and error checks.
3.	Familiarity with Monitoring system	L	This is 15 th monitoring period (6 th period of second crediting period). Application of new methodology does not impact on the familiarity of monitoring system. Expert organization is involved in the periodic inspection of monitoring equipment	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 were introduced in the 2 nd crediting period will be checked especially.
4.	QA/QC	L	Stable QA/QC system has been implemented	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.
5.	Data flow	M	Most data are transmitted to the spreadsheet automatically except for nitric acid concentration	In response to that risk, the KFQ verification team checks 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.
6.	Calculation	M	Calculation is performed in excel spreadsheet applying formulae. However, recalculation is	Firstly, check any omissions of events for recalculation. And then review all recalculation.

			<i>done by manually.</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 on the application of materiality in verifications (version 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 findings, 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 13/04/2021, published on 14/04/2020) and emission reduction calculation spreadsheets. Furthermore, the registered 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 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 17/05/2021. 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 record 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: 17/05/2020				
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	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
2.	Review of the complete data flow from data generation, aggregation, recording, calculation to reporting of the monitoring parameters	Onsan plant	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
3.	Confirmation of the complete & correct implementation of procedures for the operation and data collection.	Onsan plant	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
4.	Verification of the information provided in the MR and documentation with other sources.	Onsan plant	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
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	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
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	17/05/2021	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH

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.	JIN	A Jin	HWC	17/05/2021	General Support, Facilities, instruments and analysis, QA/QC calculation	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
2.	LEE	Yu Jeong	Roen Consulting Co., Ltd.	17/05/2021	CDM coordination	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH
3.	No	Seol Ji	Roen Consulting Co., Ltd.	17/05/2021	CDM coordination	Pyung Hee JANG Su Hyun PARK Jae Ryoung OH

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	0	0	0
Compliance of the project implementation and operation with the registered PDD	1	0	0
Post-registration changes	0	0	0
Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines	0	0	0
Compliance of monitoring activities with the registered monitoring plan	1	2	0
Compliance with the calibration frequency requirements for measuring instruments	1	1	0
Assessment of data and calculation of emission reductions or net removals	0	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	3	3	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:

- i. 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;
- ii. Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by PP;
- iii. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impact the quantity of emission reductions;
- iv. 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.

3 CLs and 3 CARs were raised for this monitoring period, which were closed successfully after PP have submitted MR (version 2.1).

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 following it.
Findings	It was found that there are no deviations between the MR (version 2.1) and the latest monitoring report form (version 08.0).
Conclusion	The verification team concludes that the MR (version 2.1) is following the latest monitoring report form (version 08.0) and the instructions therein.

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> <p>Consecutive monitoring period</p> <p>The verification team checked monitoring period of previous verifications through interviews with staff from HWC as well as history of requests for issuance provided by UNFCCC website to confirm consecutive monitoring periods of this project</p>
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	activity.
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 August 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 registered PDD (version 14) as well as PRC-0922-002). The change on physical 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 PDD. During the on-site visit KFQ inspected the installation of the DeN₂O Unit and all instruments 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 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 PDD.</p> <p><u>Actual operation of the project during the monitoring period:</u></p> <p>During the monitoring period, in total lasting for 366 days, the nitric acid plant as well as its DeN₂O system was in normal operation. PP has provided description of operational event in the MR (version 1.0). However, missing event and errors in event end time and total duration were found. (<u>Refer to / Table 2/ Appendix 4 / CL ID 01</u>). Regarding CL, PP rearranged operational events and corrected end time and total duration and reason of each events in the revised MR.</p> <p>After PP submitted the revised MR, the verification team confirmed the description of operational events is clearly and sufficiently described in the MR (version 2.1). The verification team checked shut down reports, the daily operation records, ABB data logging and DCS etc., and also interviewed relevant plant staff of HWC. The verification team also checked recalculation process of baseline emissions and N₂O emissions of event periods is completely and correctly implemented in ER calculation sheet with a conservative manner.</p> <p>The monitoring system & data collection system were operational during the monitoring period - the maintenance/calibration periods of the monitoring instruments performed during the monitoring period and as described in the monitoring report are complete, respective re-calculation of N₂O emissions during times of observations (if applicable) were done correctly & conservatively in the project spreadsheets and in accordance with the registered PDD and the applied methodology. It is identified that instruments have been regularly calibrated.</p> <p>And the verification team checked the MR (version 2.1) and concluded that updated organizational structure of HWC were properly reflected in section C of the MR. The latest organizational arrangements were checked by means of interview with relevant staff from HWC and by means of review its supporting material.</p> <p><u>Consecutive monitoring period</u></p> <p>This is the 15th monitoring period since registration of this project activity. Previous</p>

	monitoring reports were already published on the UNFCCC CDM website in a consecutive manner and completed verification of their respective monitoring periods. Thus, the verification team of this monitoring period confirms monitoring periods of this project have been consecutive.
Conclusion	<p>The raised CL (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 PDD; and • All other relevant information provided in the monitoring report is fully in accordance with respective information stated in the registered PDD; and • The information on project operation, the management system and quality assurance are complete, correct and in accordance with the registered 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 PDD; and • The monitoring periods of this project have been consecutive.

E.4. Post-registration changes

E.4.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents¹

Temporary deviations from registered monitoring plan (ref. No. PRC-0922-005) in 14th monitoring period was approved on 16/01/2021 and applicable period for approved deviation is from 01/01/2019 to 17/09/2020. Duration from 01/01/2020 to 17/09/2020 is corresponded to 15th monitoring period.

After expiry of the applicable period of temporary deviation in 14th monitoring period, there is a proposed temporary deviation from registered monitoring plan applied to 15th monitoring period due to delayed AST which was implemented on 28~29/10/2020. The temporary deviation is submitted and request for approval under issuance track of this monitoring period as below:

- Temporary deviation period: 18/09/2020 ~ 29/10/2020
- Application period of temporary deviation to this monitoring period: 18/09/2020 ~ 29/10/2020
- Reason for deviation: The measurement of moisture content of the gaseous stream at normal conditions ($C_{H_2O,t,db,n}$) applied to this deviation period was not met requirement that three consecutive measurements performed in the same day (at least 2 hours each) of the applied tool and registered monitoring plan in the PDD.

Please refer to the PRC validation report (version 01.1, 10/09/2021 for proposed PRC) for details

Other temporary deviations from registered monitoring plan have applied to 11th, 12th and 14th monitoring period.

1. 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

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

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)

2. 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: N/A
 - 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)
3. Approval date and ref. No.: 21/06/2021 (ref. No. PRC-0922-005)
 - Temporary deviation period: 01/01/2019 ~ 17/09/2020
 - Application period of temporary deviation to this monitoring period: 01/01/2019 ~ 31/12/2019
 - Reason for deviation: The measurement of moisture content of the gaseous stream at normal conditions ($C_{H_2O,t,db,n}$) applied to this monitoring period was not met requirement that three consecutive measurements performed in the same day (at least 2 hours each) of the applied tool and registered monitoring plan in the PDD.

Please refer to the relevant PRC validation reports (23/12/2015 for PRC-0922-001, 22/05/2017 for PRC-0922-003 and 21/06/2021 for PRC-0922-005) for details.

E.4.2. Corrections

There were no corrections that have been approved during this monitoring period or are to be submitted with the request for issuance.

There were corrections have been approved by the Board prior to the submission of the request of issuance for this monitoring period.

1. Correction with regard to accuracy level of NDIR has been approved by Board 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-0922-002) for details.
2. Correction with regard to parameter ' $P_{production,y}$ ' which is production of nitric acid in year y in PDD has been approved by Board on 28/03/2019. The reference number of the correction is PRC-0922-004 and please refer to the PRC validation report (02/01/2019 for PRC-0922-004) for details.

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

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 methodological regulatory documents

There were no corrections have been approved during this monitoring period or are to be submitted with the request for issuance.

Other permanent changes have applied to 11th and 12th monitoring period.

1. Approval date and ref. No.: 19/09/2016 (effective approval date: 18/09/2016) and ref. No. PRC-0922-002)
 - 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'.
2. Approval date and ref. No.: 28/03/2019 and ref. No. PRC-0922-004
 - Changes of the nitric acid flow meter: PP changed the flow meter in order to improve accuracy of the meter. Thus, PP revised registered PDD (version 14.0) to reflect specification of a new flow meter.
 - 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 the information of monitoring HNO₃ concentration in revised PDD.

Please refer to the relevant PRC validation reports (06/07/2016 for PRC-0922-002, 02/01/2019 for PRC-0922-004) for details.

E.4.6. Changes to the project design

There was a change 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-0922-002) for details.

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

N/A

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

Means of verification	The KFQ verification team reviewed the monitoring plan contained in the registered PDD against the approved methodology, ACM0019 (version 02.0) and the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0) and the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (version 02.0) was applied to this project activity.
Findings	The KFQ verification team found that there are no incompliance between the applicable registered and revised monitoring plan, the applied methodology ACM0019 (version 02.0) and of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0) and of the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (version 02.0). Furthermore, it was found that there are no standardized baselines applied in the project activity.
Conclusion	KFQ confirms that the registered monitoring plan is in accordance with the approved methodology applied by the project activity ACM0019 (version 02.0) and of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0) and of the "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (version 02.0). There is also no applicable standardized baseline for the project activity.

E.6. Compliance of monitoring activities with the registered monitoring plan

E.6.1. Data and parameters fixed ex ante or at renewal of crediting period

Means of verification	'Data and parameters fixed ex-ante' listed in the MR have been crosschecked &
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	reviewed against – as applicable – the monitoring plan contained in the registered PDD as well as applied methodology ACM0019 (version 02.0) including applicable tools and other relevant CDM related documentation.			
Findings	'Data and parameters fixed ex-ante' have been reviewed against the registered PDD, applied methodology ACM0019 (version 02.0) and Tool to determine the mass flow of a greenhouse gas in a gaseous steam (version 02.0).			
	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} (kgN ₂ O/tHNO ₃ , Historical baseline emission factor of the Nitric acid plant)	Historical information from issuance reports of CDM-PDD documents	9.47	For plants that used 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. 02.0)	11.2 (in 2020)	According to the applied methodology, EF _{default,y} during the year of 2020, is 11.2 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. 02.0)	2.50 (in 2020)	According to the applied methodology, EF _{new,y} during the year of 2020, is 2.50 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 2 nd crediting period)	PDD	107,100	According to the applied methodology, P _{product, max} should be the designed capacity applied during the 2 nd crediting period. In the registered PDD, the value of 107,100t/y was applied.
	• GWP _{N₂O}	Relevant	298	According to the

	(tCO ₂ e/tN ₂ O, Global warming potential of N ₂ O)	decision by the CMP		“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 in a gaseous stream” (ver. 02.0)	8,314	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 02.0”, the universal ideal gases constant is 8,314 Pa.m ³ /kmol.K.
	• MMi (kg/kmol, Molecular mass of greenhouse gas i)	PDD / “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (ver. 02.0)	44.02	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 02.0”, 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. 02.0)	101,325	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 02.0”, 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. 02.0)	273.15	According to “Tool to determine the mass flow of a greenhouse gas in a gaseous steam, version 02.0”, Temperature at normal conditions is 273.15K.
	Furthermore, emission reduction is correctly calculated in the latest MR (version 2.1) and ER calculation sheet (version 2.1).			
Conclusion	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. All values are following relevant documentation such as the registered PDD & monitoring plan as well as the applied methodology, applied tools and other CDM related documentation, where applicable.			

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 14.0) and proposed temporary deviation. The

monitoring has been carried out in accordance with the monitoring plan, and all parameters were monitored and determined as per the monitoring plan except the parameters monitored according to the proposed PRC. 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 and the monitoring plan as per the applied methodology ACM0019 (version 02.0). 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 02.0), monitoring plan contained in the registered PDD and proposed temporary deviation from the registered monitoring plan.

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

Data/Parameter	$P_{\text{production,y}}$
Data Unit	t HNO_3
Description	Nitric acid produced in the monitoring period n
Source of data used	- DCS monthly sheet (for flow of nitric acid), - Daily analysis sheet (for HNO_3 concentration) - Measuring device (Flow meter, specific gravity hydrometer, thermometer)
Value(s)	-120,844 t HNO_3 (total production from 01/01/2020 to 31/12/2020, the maximum production value: 107,100 t HNO_3 /y)
Means of verification	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 HNO_3 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.

	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.															
Findings	<p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR (version 2.1). 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. During this monitoring period, PP replaced the nitric acid flow meter on 10/04/2020 with new one of same model as below:</p> <table><tr><td></td><td>Previous flow meter</td><td>latest flow meter during monitoring period</td></tr><tr><td>Manufacturer</td><td>EMERSON</td><td>EMERSON</td></tr><tr><td>Model No.</td><td>CMF200L518N2BIEZZZ</td><td>CMF200L518N2BIEZZZ</td></tr><tr><td>Serial number</td><td>14506121</td><td>14675545</td></tr><tr><td>Reason</td><td colspan="2">Conducting calibration</td></tr></table> <p>However, the verification team found that nitric acid flow meter was replaced during this monitoring period and equipment serial number/ date of calibration/ validity of replacement in MR (version 1.0) is incorrectly indicated (Refer to Appendix 4 / Table 2 / CL ID 02). Regarding this CL, PP revised the information of the flow meter in monitoring report according to the actual installation and calibration. The verification team reviewed relevant documents as well as site inspection and confirmed that all replacement information is correctly described in the MR (version 2.1).</p> <p>Produced HNO₃ concentration was monitored by laboratory analysis that conducted by staffs of HWC according to HWC's internal standard for testing HNO₃. The staffs measure specific gravity and temperature of HNO₃ produced on a daily basis using a specific gravity and a thermometer. The verification team visited the laboratory during on-site inspection and interviewed one of testing staffs to verify that the measurement is carried out in accordance with the registered monitoring plan.</p> <p>To determine HNO₃ concentration, specific gravity method which is designed by plan engineering company (UHDE) is applied with daily measured specific gravity and temperature. 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 2.1).</p> <p>Consequently, the verification team confirms that calculation of HNO₃ concentration is well implemented for this monitoring period according to the registered monitoring plan. Also, the measured amount and the concentration of HNO₃ is input in ER sheet and converted to the amount of HNO₃ as 100%. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>However, value of the monitored parameters is not consistently provided in the MR (version 01.0) with it in ER calculation (version 01.0) (Refer to Appendix 4 / Table 3/ CAR ID 02). After PP submitted revised ER calculation sheet and MR, the verification team checked the value in the MR and ER calculation sheet and concluded that parameters are correctly reflected in the ER calculation (version 2.1) and indicated in MR (version 2.1).</p> <p>The calibration and maintenance routines for the parameter are the responsibility</p>		Previous flow meter	latest flow meter during monitoring period	Manufacturer	EMERSON	EMERSON	Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ	Serial number	14506121	14675545	Reason	Conducting calibration	
	Previous flow meter	latest flow meter during monitoring period														
Manufacturer	EMERSON	EMERSON														
Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ														
Serial number	14506121	14675545														
Reason	Conducting calibration															

	<p>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> <p>$P_{\text{production},y}$ for this monitoring period is finally determined as 120,844 tHNO₃ which is slightly increased compare to the MR (version 1.0) due to PP response to CAR ID 02 and the verification team confirmed that it is correctly indicated in MR (version 2.1) and reflected in ER calculation (version 2.1).</p>
Conclusion	<p>The raised CL (ID 02) and CAR (ID 02) have 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 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 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)	8,356 (total value in the monitoring period)															
Means of verification	Measurements by nitric acid flow meter have been chosen in order to determine whether or not the nitric acid plant is in operation. 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.															
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>During this monitoring period, PP replaced the nitric acid flow meter on 10/04/2020 with new one of same model as below:</p> <table><tr><th></th><th>Previous flow meter</th><th>latest flow meter during monitoring period</th></tr><tr><td>Manufacturer</td><td>EMERSON</td><td>EMERSON</td></tr><tr><td>Model No.</td><td>CMF200L518N2BIEZZZ</td><td>CMF200L518N2BIEZZZ</td></tr><tr><td>Serial number</td><td>14506121</td><td>14675545</td></tr><tr><td>Reason</td><td colspan="2">Conducting calibration</td></tr></table> <p>According to the monitoring plan, measurements by the 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>However, the verification team found the numbers of hours of operation (h_y) is not correctly calculated in the ER calculation sheet (Refer to Appendix 4 / Table 3 / CAR ID 02). PP submitted revised MR (version 2.1) and corrected the editorial</p>		Previous flow meter	latest flow meter during monitoring period	Manufacturer	EMERSON	EMERSON	Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ	Serial number	14506121	14675545	Reason	Conducting calibration	
	Previous flow meter	latest flow meter during monitoring period														
Manufacturer	EMERSON	EMERSON														
Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ														
Serial number	14506121	14675545														
Reason	Conducting calibration															

	<p>error in the revised ER calculation sheet (version 2.1). h_y for this monitoring period is finally determined as 8,356 h which is slightly increased compare to the MR (version 1.0) due to PP response to CAR ID 02 and the verification team confirmed that it is correctly indicated in MR (version 2.1) and reflected in ER calculation (version 2.1).</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 CAR (ID 02) 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 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)	2 (total value in the monitoring period)
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>However, value of the monitored parameters is not consistently provided in the MR (version 01.0) with it in ER calculation (version 01.0) as 0 and 2 respectively <u>(Refer to Appendix 4 / Table 3 / CAR ID 02).</u></p> <p>Regarding this CAR, PP submitted revised ER calculation sheet and MR, the verification team checked the value in the MR and ER calculation sheet and concluded that parameters are correctly reflected in the ER calculation (version 2.1) and indicated in MR (version 2.1). $h_{r,y}$ for this monitoring period is finally determined as 2 hours.</p>
Conclusion	<p>The raised CAR (ID 02) has been completely resolved.</p> <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>

	KFQ confirms that the QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.
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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)	375,218,620 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 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 02.0).</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. The absolute pressure transmitter and the resistance temperature detector were replaced by the same model in 04/04/2020. 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 manufactures (Honeywell and Wise Control Inc.). 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 measured (read every 1 second) and hourly average values are recorded based on temperature and pressure compensated flow rate. And it is transferred to ABB data logging system.</p> <p>However, value of the monitored parameters is not consistently provided in the MR (version 01.0) with it in ER calculation (version 01.0) as 375,679,309 and 375,197,735 respectively <u>(Refer to Appendix 4 / Table 3 / CAR ID 02).</u></p> <p>Regarding this CAR, PP submitted revised ER calculation sheet and MR. The verification team checked the value in the MR and ER calculation sheet and concluded that parameters are correctly reflected in the ER calculation (version 2.1) and indicated in MR (version 2.1).</p> <p>Monitoring results are fully available at the required intervals for the whole monitoring period. According to the applied methodology, if data for neither $V_{t,db}$ nor $V_{i,t,db}$ are available for more than 1/3 of any hour while the plant was in operation the maximum value of mass flow of N₂O calculated during the monitoring period shall be applied to any such hour. For 06/08/2020 14:00~15:00, the N₂O concentration and the volume flow of the tail gas were not available, so PP applied the maximum value of mass flow of N₂O during this monitoring period that of 115.998 kgN₂O/h measured on 23/11/2020 10:00 is applied. The verification team reviewed relevant evidences as well as site inspection and confirmed the adjusted value is complied with the requirement of the methodology.</p> <p>The verification team checked that whether determination and application of maximum value of the parameters during this monitoring period are in accordance with applied methodology and registered monitoring plan. The verification team concluded that respective re-calculations of N₂O emissions during times of observations were done correctly & conservatively in the ER calculation and in accordance with the registered PDD and the applied methodology.</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.</p> <p>As for the calibration, the calibration and replacement were delayed, calibration of Absolute Pressure Transmitter was delayed from 00:00 on 02/04/2020 to 23:00 on 02/04/2020. Also, the calibration and replacement of Absolute Pressure Transmitter and Resistance Temperature Detector were delayed from 00:00 on 03/04/2020 to 08:00 on 04/04/2020. So, PP adjusted the values with conservative approach, however, we found out that adjusted parameter was not clearly identified and the adjustment was not in accordance with the requirement, article 366 (b) of VVS (version 02.0) <u>(Refer to Appendix 4 / Table 3 / CAR ID 03).</u></p> <p>Regarding this CAR, PP adjusted the value of $V_{t,db}$ applying the error identified in the delayed calibration test (1% of Residence temperature detector and 0.8% of Absolute pressure transmitter) in the delayed calibration according to VVS article 366 (b). And PP submitted the revised MR (version 2.1), ER calculation sheet (version 2.1), Conservative calculation sheet (version 01) and relevant evidences to reflect the adjusted values.</p> <p>The verification team checked calibrations reports and found out that an error identified in the delayed calibration test is 1% of Residence temperature detector and 0.8% of Absolute pressure transmitter respectively and these values are beyond the maximum permissible error of the equipment.</p> <p>Moreover, the verification team reviewed how to calculate $V_{t,db}$ applying the adjusted values in Conservative calculation sheet (version 01). Specification manual of Differential Pressure Transmitter (D-FL-100, manufacturer: DURAG) is described calculation formula of volumetric flow. The equation and relevant parameters are explained in the specification manual and this calculation formula is consistently applied in Conservative calculation sheet (version 01). Adjustment of $V_{t,db}$ is also calculated conservatively. Please refer to "Conservative calculation sheet" for details.</p> <p>The verification team confirms that the measured values of the instrument during the delayed calibration period are correctly recalculated by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0).</p> <p>$V_{t,db}$ for this monitoring period is finally determined as 375,197,735 Nm³ dry gas/h which is slightly decreased compared to the MR (version 1.0) due to PP response to CAR ID 02 and the verification team confirmed that it is correctly indicated in MR (version 2.1) and reflected in ER calculation (version 2.1).</p>
Conclusion	<p>The raised CARs (ID 02 and 03) have 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.</p> <p>KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the measured values during delayed calibration period is correctly adjusted by applying conservatively the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (ver.02.0) (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)	8.03x10 ⁻⁵ m ³ N ₂ O gas /Nm ³ dry gas (total average volumetric fraction from 01/01/2020 to 31/12/2020 from the actual data)
Means of verification	The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied

	<p>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 N_2O is automatically generated. The verification team could check the hourly average N_2O concentration in the monthly data sheet and the N_2O concentration on the monthly data sheet was consistency with the data in the ER calculation sheet.</p> <p>However, value of the monitored parameters is not consistently provided in the MR (version 1.0) with it in ER calculation (version 1.0) as 7.93×10^{-5} and 6.97×10^{-5} respectively <u>(Refer to Appendix 4 / Table 3 / CAR ID 02).</u></p> <p>Regarding this CAR, PP submitted revised ER calculation sheet and MR which are described data from the omitted events (06:00~13:00 on 19/12/2020). The verification team checked the value in the MR and ER calculation sheet with relevant evidences and concluded that parameters are correctly reflected in the ER calculation sheet (version 2.1) and indicated in MR (version 2.1).</p> <p>According to the applied methodology, if data for the $V_{i,t,db}$ is not available for more than 1/3 of any hour while the plant was in operation, the value for the hour shall be replaced with the maximum value of them observed during this monitoring period. And if data for neither $V_{t,db}$ nor $V_{i,t,db}$ are available for more than 1/3 of any hour while the plant was in operation the maximum value of mass flow of N_2O calculated during the monitoring period shall be applied to any such hour. For 06:00 on 19/12/2020 ~14:00 on 19/12/2020, the N_2O concentration of the tail gas was not available because of the malfunction more than 1/3 of any hour while the plant was in operation. So, PP applied maximum value of concentration of N_2O calculated value 1,211ppm (10:00 on 28/12/2020). The verification team reviewed relevant evidences as well as site inspection and confirmed the adjusted value is complied with the requirement of the methodology.</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.</p> <p>$V_{i,t,db}$ for this monitoring period is finally determined as $8.03 \times 10^{-5} \text{ m}^3/\text{Nm}^3$ which is slightly increased compared to the MR (version 01.0) due to PP response to CAR ID 02 and 03. And the verification team confirmed that it is correctly indicated in MR (version 2.1) and reflected in ER calculation (version 2.1).</p>
Conclusion	<p>The raised CAR (ID 02) 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.</p>

	KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology. Details on calibration are given in section E.7 below.
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Data/Parameter	C _{H2O,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)	0.0063 kgH ₂ O/m ³ dry gas (QAL2 in 18/09/2019~20/09/2019) 0.0005 kgH ₂ O/m ³ dry gas (AST in 27/10/2020~28/10/2020)																																			
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	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 Nederland BV) coinciding with AST/QAL2 reference measurements (QAL2: 18/09/2019~20/09/2019, AST: 27/10/2020~28/10/2020). The repeated measurements were conducted in accordance with USEPA CF42 method 4.																																			
	<table><tr><th>Type</th><th>Date</th><th>Time</th><th>Hours</th><th>Measured value (kgH₂O/m³ dry gas)</th><th>Average value of three consecutive measurement (kgH₂O/m³ dry gas)</th></tr><tr><td rowspan="3">QAL2</td><td rowspan="3">18~20/09/2019</td><td>10:26~11:45</td><td>1:19</td><td>0.0067</td><td rowspan="3">0.0063</td></tr><tr><td>13:05~14:05</td><td>0:30</td><td>0.0062</td></tr><tr><td>14:05~14:35</td><td>0:30</td><td>0.0059</td></tr><tr><td rowspan="3">AST</td><td rowspan="3">27~28/10/2020</td><td>11:28~13:28</td><td>2:00</td><td>0.00074</td><td rowspan="3">0.0005</td></tr><tr><td>13:28~15:28</td><td>2:00</td><td>0.00049</td></tr><tr><td>15:29~17:29</td><td>2:00</td><td>0.00053</td></tr></table>						Type	Date	Time	Hours	Measured value (kgH ₂ O/m ³ dry gas)	Average value of three consecutive measurement (kgH ₂ O/m ³ dry gas)	QAL2	18~20/09/2019	10:26~11:45	1:19	0.0067	0.0063	13:05~14:05	0:30	0.0062	14:05~14:35	0:30	0.0059	AST	27~28/10/2020	11:28~13:28	2:00	0.00074	0.0005	13:28~15:28	2:00	0.00049	15:29~17:29	2:00	0.00053
	Type	Date	Time	Hours	Measured value (kgH ₂ O/m ³ dry gas)	Average value of three consecutive measurement (kgH ₂ O/m ³ dry gas)																														
	QAL2	18~20/09/2019	10:26~11:45	1:19	0.0067	0.0063																														
			13:05~14:05	0:30	0.0062																															
			14:05~14:35	0:30	0.0059																															
	AST	27~28/10/2020	11:28~13:28	2:00	0.00074	0.0005																														
			13:28~15:28	2:00	0.00049																															
			15:29~17:29	2:00	0.00053																															
	As for AST in 2020, three consecutive measurements (at least 2 hours each) for moisture content of the gaseous stream at normal conditions in same day were performed between 11:28~13:28, 13:28~15:28 and 15:29~17:29 on 28/10/2020. The measured values are 0.00074, 0.00049 and 0.00053 kg H ₂ O/m ³ dry gas respectively and mean value of three consecutive measurement is 0.5 g H ₂ O/m ³ dry gas (equivalent to 0.0005 kg H ₂ O/m ³ dry gas). The repeated measurement results provided in AST report by SGS Nederland BV have been verified against the requirement out of the monitoring plan and the applied methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0)”.																																			
In case of QAL2 in 2019, three consecutive measurements for moisture content of the gaseous stream at normal conditions in same day were performed between 10:26~11:45, 13:05~14:05 and 14:05~14:35 on 19/09/2019. The measured values are 0.0067, 0.0062 and 0.0059 kg H ₂ O/m ³ dry gas respectively and mean value of three consecutive measurement is 6.3 g H ₂ O/m ³ dry gas (equivalent to 0.0063 kg H ₂ O/m ³ dry gas). Even though, QAL2 was conducted, it is not complied with the monitoring plan (at least 2 hours each), thus, during previous monitoring period, PP applied the PRC (Temporary Deviation) and received the approval (PRC-0922-005) with applicable period (01/01/2019 ~17/09/2020). However, AST was actually conducted on 29/10/2020 and we found that duration (18/09/2020 ~29/10/2020) is not complied with the requirement of at least 2 hours each <u>(Refer to Appendix 4 / Table 3 / CAR ID 01).</u>																																				
Regarding this CAR, PP decided to request for approval of proposed monitoring plan temporarily deviated from the registered monitoring plan for C _{H2O,t,db,n} to reflect actual monitoring result.																																				

	<p>It was found that the adjusted moisture content of the gaseous stream as per the proposed temporary deviation is still below the maximum threshold value of 0.05 kg H₂O/m³ dry gas. Therefore, as stated by the PP in the MR and according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0)", the gaseous stream is to be considered dry.</p> <p>Please refer PRC validation report (version 01.1, 10/09/2021) for further details.</p>
Conclusion	<p>The raised CAR (ID 01) 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 proposed temporary deviation from the registered monitoring plan 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 and proposed temporary deviation from the registered monitoring plan.</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 Nederland BV).</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 verification team confirms that the calibration frequency requirements for measuring instruments comply with ACM0019 (version 02) 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 02), the monitoring plan in the registered PDD. KFQ confirms, if applicable, that the measured values during the delayed calibration period is correctly adjusted by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0).

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 HNO₃	
	I.D.	10-FT-512	
	Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ
	Serial number	14506121	14675545
	Manufacturer	EMERSON	EMERSON
	Accuracy level	0.1	0.1
	Period of use	31/01/2019~09/04/2020 (retired on 10/04/2020)	10/04/2020 ~ present
Type	Coriolis mass flow meter		
Calibration Entity	FM Tech Co., Ltd.		
Calibration frequency	15 Months		
Previous/latest calibration		Previous flow meter	Current flow meter
	Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ
	Serial number	14506121	14675545
	Date of calibration	31/01/2019	10/04/2020

	validity	30/04/2020	09/07/2021
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	<p>Flow meter's location has been confirmed by physical inspection during on-site visit. It was verified 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.</p>		
	<p><u>Measuring instrument for HNO₃ concentration</u></p> <p>For calculation of nitric acid produced and determining HNO₃ concentration, specific gravity hydrometer and liquid-in-glass thermometer are used in this project activity. So, PP uses those measuring instrument (manufactured by Daekwang Inc. and Dongmyung Inc.) with accuracy and calibration frequency are as below:</p>		
	Instrument type	Specific gravity hydrometer	Liquid-in-glass thermometer
	Accuracy	< ± 0.002kg/m ³	<± 1°C
	Calibration frequency	36 months	12 months
	<p>According to the registered PDD, HWC applied calibration frequency of each measuring instrument as per manufacture's (Daekwang Inc.'s and Dongmyung Inc.) recommendation with reference to "Enforcement Rule on operation accreditation system of national calibration institutes". The verification team checked that monitoring equipment used for determining HNO₃ concentration are controlled and calibrated by replacing with new one before expiration of validity. And replaced new one is calibrated with reference instrument in manufacturing process and the instrument is calibrated by the 3rd party with national accreditation (KOLAS).</p> <p>Also, the verification team cross-checked date of replacement by documented purchase history for whole monitoring period and concluded that adjustment due to delayed calibration is not needed for this monitoring period.</p>		
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 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.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ
	Serial number	14506121	14675545
	Manufacturer	EMERSON	EMERSON
	Accuracy level	0.1	0.1
	Period of use	31/01/2019~09/04/2020 (retired on 10/04/2020)	10/04/2020~present
Type	Coriolis mass flow meter		
Calibration Entity	FM Tech Co., Ltd.		
Calibration frequency	15 Months		

Previous/latest calibration		Previous flow meter	Current flow meter
	Model No.	CMF200L518N2BIEZZZ	CMF200L518N2BIEZZZ
	Serial number	14506121	14675545
	Date of calibration	31/01/2019	10/04/2020
	validity	30/04/2020	09/07/2021
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. It was verified 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. The verification team has checked the revised MR (version 2.1) and confirmed that information of monitoring equipment including date of calibration and validity is properly stated in the MR as per the registered monitoring plan.		
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	m³ 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.	1257760	0712 07030214002
	Manufacturer	Durag	Honeywell
	Accuracy level	± 2%	± 0.075%
	Period of use	20/09/2016~present	Spare (Not used after 2014)
Calibration frequency	For serial No. 1257760: 36 months for QAL2 / 12 months for AST		
Previous/latest calibration	I.D.	10-FT-562	
	Instrument No.	1 st equipment	
	Serial No.	1257760	
	Tag	QAL2	AST
	Date of calibration	18/09/2019~20/09/2019	28/10/2020~29/10/2020
	validity	17/09/2022	27/10/2021
	Calibration entity	SGS Nederland BV	
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. And the verification team verified 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 Nederland BV as below:</p> <table border="1"> <thead> <tr> <th colspan="4">History of QAL2 and AST regarding 15th monitoring period</th> </tr> <tr> <th>Period measurement</th><th>Type of test</th><th>Validity</th><th>Calibration frequency</th></tr> </thead> <tbody> <tr> <td>18/09/2019~20/09/2019</td><td>QAL2</td><td>17/09/2022</td><td>3 years</td></tr> <tr> <td>28/10/2020~29/10/2020</td><td>AST</td><td>27/10/2021</td><td>12 months</td></tr> </tbody> </table> <p>The verification team checked a calibration interval between QAL2 in 2019 and AST in 2020 and confirmed that exceeding period between QAL2 and AST is permitted by 2 months through reviewing of internal procedure of SGS Nederland BV. Thus, we concluded that calibration covering the whole monitoring period is available for the used equipment.</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"> <thead> <tr> <th>Period</th><th>Applied correction factor of $V_{t,db}$</th></tr> </thead> <tbody> <tr> <td>01/01/2020~ 31/12/2020</td><td>$1.050 \times \text{flow}[\text{m}^3/\text{h}] + 0.00$</td></tr> </tbody> </table> <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 14181² and '6.2.1 in Technical Report on Guidance on the application of EN 14181³. 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>The verification team checked that the differential pressure transmitter, 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>			History of QAL2 and AST regarding 15 th monitoring period				Period measurement	Type of test	Validity	Calibration frequency	18/09/2019~20/09/2019	QAL2	17/09/2022	3 years	28/10/2020~29/10/2020	AST	27/10/2021	12 months	Period	Applied correction factor of $V_{t,db}$	01/01/2020~ 31/12/2020	$1.050 \times \text{flow}[\text{m}^3/\text{h}] + 0.00$
History of QAL2 and AST regarding 15 th monitoring period																							
Period measurement	Type of test	Validity	Calibration frequency																				
18/09/2019~20/09/2019	QAL2	17/09/2022	3 years																				
28/10/2020~29/10/2020	AST	27/10/2021	12 months																				
Period	Applied correction factor of $V_{t,db}$																						
01/01/2020~ 31/12/2020	$1.050 \times \text{flow}[\text{m}^3/\text{h}] + 0.00$																						
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.																						
Type	Absolute Pressure Transmitter																						
I.D/ Serial No.	I.D.	10-PT-362																					
	Instrument No.	1 st equipment	2 nd equipment																				
	Serial No.	0712 07030214003	9853 00002001004																				

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

³ 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)

	Manufacturer	Honeywell	
	Accuracy level	± 0.075%	
	Period of use	22/01/2019 ~ 03/04/2020	04/04/2020 ~ present
Calibration frequency	15 months		
Previous/latest calibration	I.D.	10-PT-362	
	Instrument No.	1 st equipment	2 nd equipment
	Serial No.	0712 07030214003	9853 00002001004
	Date of calibration	03/01/2019	02/04/2020
	Validity	02/04/2020	01/07/2021
	Calibration Entity	Korea Instrument Co., Ltd.	FM Tech Co., Ltd.
The applied period of max. permissible error when applicable	Values of Absolute pressure transmitter were applied the error identified in the delayed calibration test from 00:00 on 02/04/2020 to 08:00 on 04/04/2020		
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 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 and as per the defined requirements. And the verification team found that there was a replacement from 1st to 2nd equipment within validity of 1st equipment on 02/04/2020.</p> <p>The verification team checked that the absolute pressure transmitter, as stated in the MR, physically exists and could be identified by the serial number. We found that calibration and replacement delay of Absolute Pressure Transmitter was raised from 00:00 02/04/2020 to on 08:00 on 04/04/2020. So, PP adjusted the values with conservative approach, however, we found out that adjusted parameter was not clearly identified and the adjustment was not in accordance with the requirement, article 366 (b) of VVS (version 02.0) <u>(Refer to Appendix 4 / Table 3 / CAR ID 03).</u></p> <p>Regarding this CAR, PP adjusted the value of $V_{t,db}$ applying the error identified in the delayed calibration test (1% of Residence temperature detector and 0.8% of Absolute pressure transmitter) in the delayed calibration according to VVS article 366 (b). And PP submitted the revised MR (version 2.1), ER calculation sheet (version 2.1), Conservative calculation sheet (version 01) and relevant evidences to reflex the adjusted values.</p> <p>The verification team checked calibrations reports and found out that an error identified in the delayed calibration test is 1% of Residence temperature detector and 0.8% of Absolute pressure transmitter respectively and these values are beyond the maximum permissible error of the equipment.</p> <p>Moreover, the verification team reviewed how to calculated $V_{t,db}$ applying the adjusted values in Conservative calculation sheet (version 01). Specification manual of Differential Pressure Transmitter (D-FL-100, manufacturer: DURAG) is described calculation formula of volumetric flow. The equation and relevant parameters are explained in the specification manual and this calculation formula is consistently applied in Conservative calculation sheet (version 01). Adjustment of $V_{t,db}$ is also calculated conservatively. Please refer to "Conservative calculation sheet" for details.</p> <p>The verification team confirms that the measured values of the instrument during the delayed calibration period are correctly recalculated by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0).</p> <p>The verification team confirms that the instrument had a valid calibration and was</p>		

	<p>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 Nederland BV from 18/09/2019 to 20/09/2019.</p>																				
Conclusion	<p>The raised CAR 03 has been completely resolved.</p> <p>KFQ confirms that the calibration has been regularly conducted and the equipment used for monitoring is controlled in accordance with the monitoring plan and the applied methodology.</p> <p>The measured values during the delayed calibration period is correctly adjusted by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0)</p>																				
Type	Resistance Temperature Detector																				
I.D/ Serial No.	<table border="1"> <tr> <td>I.D.</td><td colspan="2">10-TT-162</td></tr> <tr> <td>Instrument No.</td><td>1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td>WS-7M423</td><td>WS-7M140</td></tr> <tr> <td>Manufacturer</td><td colspan="2">Wise controls</td></tr> <tr> <td>Accuracy level</td><td colspan="2">± 0.3 %</td></tr> <tr> <td>Period of use</td><td>22/01/2019~ 03/04/2020</td><td>02/04/2020~ present</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	22/01/2019~ 03/04/2020	02/04/2020~ present
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	22/01/2019~ 03/04/2020	02/04/2020~ present																			
Calibration frequency	15 months																				
Previous/latest calibration	<table border="1"> <tr> <td>I.D.</td><td colspan="2">10-TT-162</td></tr> <tr> <td>Instrument No.</td><td>1st equipment</td><td>2nd equipment</td></tr> <tr> <td>Serial No.</td><td>WS-7M423</td><td>WS-7M140</td></tr> <tr> <td>Date of calibration</td><td>02/01/2019</td><td>02/04/2020</td></tr> <tr> <td>validity</td><td>01/04/2020</td><td>01/07/2021</td></tr> <tr> <td>Calibration Entity</td><td>Korea Instrument Co., Ltd</td><td>FM Tech Co., Ltd.</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	02/01/2019	02/04/2020	validity	01/04/2020	01/07/2021	Calibration Entity	Korea Instrument Co., Ltd	FM Tech Co., Ltd.
I.D.	10-TT-162																				
Instrument No.	1 st equipment	2 nd equipment																			
Serial No.	WS-7M423	WS-7M140																			
Date of calibration	02/01/2019	02/04/2020																			
validity	01/04/2020	01/07/2021																			
Calibration Entity	Korea Instrument Co., Ltd	FM Tech Co., Ltd.																			
The applied period of max. permissible error when applicable	Values of Residence temperature detector were applied the error identified in the delayed calibration test from 00:00 on 03/04/2020 to 08:00 on 04/04/2020																				
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 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 and as per the defined requirements. And the verification team checked that there was a replacement from 1st to 2nd equipment within validity of 1st equipment on 01/04/2020.</p> <p>We found that calibration and replacement delay of Residence temperature detector was raised from 00:00 on 03/04/2020 to 08:00 on 04/04/2020. So, PP adjusted the values with conservative approach, however, we found out that adjusted parameter was not clearly identified and the adjustment was not in accordance with the requirement, article 366 (b) of VVS (version 02.0) <u>(Refer to Appendix 4 / Table 3 / CAR ID 03).</u></p> <p>Regarding this CAR, PP adjusted the value of $V_{t,db}$ applying the error identified in the delayed calibration test (1% of Residence temperature detector and 0.8% of Absolute pressure transmitter) in the delayed calibration according to VVS article 366 (b). And PP submitted the revised MR (version 2.1), ER calculation sheet (version 2.1), Conservative calculation sheet (version 01) and relevant evidences to reflex the adjusted values.</p> <p>The verification team checked calibrations reports and found out that an error identified in the delayed calibration test is 1% of Residence temperature detector and 0.8% of Absolute pressure transmitter respectively and these values are</p>																				

	<p>beyond the maximum permissible error of the equipment.</p> <p>Moreover, the verification team reviewed how to calculate $V_{t,db}$ applying the adjusted values in Conservative calculation sheet (version 01). Specification manual of Differential Pressure Transmitter (D-FL-100, manufacturer: DURAG) is described calculation formula of volumetric flow. The equation and relevant parameters are explained in the specification manual and this calculation formula is consistently applied in Conservative calculation sheet (version 01). Adjustment of $V_{t,db}$ is also calculated conservatively. Please refer to "Conservative calculation sheet" for details.</p> <p>The verification team confirms that the measured values of the instrument during the delayed calibration period are correctly recalculated by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0).</p> <p>The verification team confirms that the instrument had a valid calibration 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 Nederland BV from 18/09/2019 to 20/09/2019.</p>
Conclusion	<p>The raised CAR 03 has been completely resolved.</p> <p>KFQ confirms that the calibration has been regularly conducted and the equipment used for monitoring is controlled in accordance with the monitoring plan and the applied methodology.</p> <p>The measured values during the delayed calibration period is correctly adjusted by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0)</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			
I.D/ Serial No.	10-AI-062/ 3.346996.7			
Type	NDIR analyzer			
Accuracy level	± 1%			
Calibration Entity	SGS Nederland BV			
Calibration frequency	36 months (EN 14181/QAL 2)			
Previous/Latest calibration	I.D.	10-AI-062		
	Serial No.	3.346996.7		
	Tag	QAL2	AST	QAL3
	Date of calibration	18/09/2019~20/09/2019	28/10/2020~29/10/2020	28/12/2020
	validity	17/09/2022	19/09/2019	08/01/2021
	Calibration entity	SGS Nederland BV		Self-calibrated
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	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>The QAL 1 report for N₂O analyzer was verified 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 Nederland BV as described in the above table of 'V_{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>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"> <thead> <tr> <th>Period</th><th>Applied correction factor of V_{t,db}</th></tr> </thead> <tbody> <tr> <td>01/01/2020~ 31/12/2020</td><td>1.005xflow[m³/h]+0.00</td></tr> </tbody> </table> <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 points 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>	Period	Applied correction factor of V _{t,db}	01/01/2020~ 31/12/2020	1.005xflow[m ³ /h]+0.00
Period	Applied correction factor of V _{t,db}				
01/01/2020~ 31/12/2020	1.005xflow[m ³ /h]+0.00				
Conclusion	KFC 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.				

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 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	The baseline GHG emissions have been found to be 312,548 tCO ₂ e 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

	<p>methodology, the monitoring plan of the registered 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. 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 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 01/01/2020 to 31/12/2020, amounting to 312,548 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 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</p>
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	<p>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 19,395 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 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 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 01/01/2020 to 31/12/2020, amounting to 19,395 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
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	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 02)
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	<p>The verification team has reviewed data, parameters and calculations with respect to calculation of the GHG emission reductions and checked them against the requirements out of the applied methodology (ACM0019_version 02.0), the registered 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 293,153 tCO₂e 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 01/01/2020. 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</p>

	<p>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 01/01/2020, 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 01/01/2020 to 31/12/2020, amounting to 293,153 tCO₂e, is correctly determined and calculated.</p>

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

Means of verification	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>Ex-ante estimation of emission reduction in the registered PDD is 243,330 tonnes of CO₂ equivalents during 366 days of the monitoring period, from 01/01/2020 to 31/12/2020. Actual emission reductions reported by the PP during this monitoring period is 293,153 tCO₂e which is higher than the value estimated in the registered PDD.</p> <p>The main reasons of the increased emission reductions are due to optimization of nitric acid production plant such as N₂O removal efficiency improvement and revamping of HNO₃ production process. 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>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 2.1) increased around 20.5 % 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 2.1) is increased around 20.5% compared to the ex-ante estimation of emission reductions in the PDD. In details, reported baseline emission is increased around 14% and reported project emission is decreased around 36.6% compared 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 are due to optimization of</p>

	nitric acid production plant such as N ₂ O removal efficiency improvement and revamping of HNO ₃ production process. Verification team checked it through interview with plant staff and record of HNO ₃ production. As a result of this optimization, HNO ₃ production has been increased by 8.7 % and the project emission is decreased as 36.6%, thus actual emission reductions are also increased around 20.5 % 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 293,153 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 PDD as well as applicable tools.
Findings	It was found that the project activity is implemented and operated according to the registered 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 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 293,153 tCO ₂ e for the covered monitoring period between 01/01/2020 to 31/12/2020. 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 1st 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 participant 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 02.0), KFQ could confirm that:

- The project activity has been implemented and operated as per the registered 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 is as per the applied methodology,
- The monitoring in the MR is as per the registered monitoring plan and proposed temporary deviation.
- 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 2.1) 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 14 of 20/12/2018
Methodology applied	ACM0019 (version 2)
The latest version of Monitoring Report	2.1 (dated 10/09/2021)
Crediting period	27/06/2014 to 26/06/2021 (2 nd crediting period)
Monitoring period	01/01/2020 to 31/12/2020 (366 days)
Total GHG emission Reductions Verified	Baseline emissions: 312,548 tonnes CO ₂ e Project emissions: 19,395 tonnes CO ₂ e Leakage: 0 tonnes CO ₂ e <u>Emission reductions: 293,153 tonnes CO₂e</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 01/01/2020 to 31/12/2020.

The project participant is 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

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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 (version 02), the registered 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 2.1 dated on 10/09/2021) and the proposed temporary deviation from the registered monitoring plan.

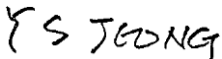
KFQ's verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. KFQ planned and performed the verification by obtaining evidence and other information and explanations that KFQ considers necessary to give reasonable 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 01/01/2020 to 31/12/2020 are fairly stated in the MR (version 2.1).

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 (version 02) and the monitoring plan in the registered PDD and the proposed temporary deviation from the registered monitoring plan.

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 01/01/2020 to 31/12/2020 are 293,153 tons of CO₂ equivalent.

Signed on behalf of the Korean Foundation for Quality

Signature : 

Name : Yu Shim JEONG, Managing Director of Energy-Climate Change
Assessment Division

Date : 30/09/2021

Appendix 1. Abbreviations

Abbreviations	Full texts
ACM	Approved consolidated methodology
AMS	Automated Measuring System
AST	Annual Surveillance Test
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
EN	European Norm
ER	Emission Reductions
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
HNO ₃	Nitric Acid
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
QAL	Quality Assurance Level
QA/QC	Quality Assurance / Quality Control
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
VVS	Clean Development Mechanism Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers



CERTIFICATE OF COMPETENCE

Name: Pyung Hee JANG

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

He is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 29 March 2019.

Sustainability Management Institute

Mi Jung LEE



CERTIFICATE OF COMPETENCE

Name: Su Hyun PARK

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

- 1.2 Renewables
- 3.1 Energy demand
- 5.2 Caprolactam, Nitric acid, Adipic acid
- 13.1 Solid waste and wastewater

She is approved as the qualification above according to the KFQ's procedure of Qualifying and Maintaining of Auditor on 18 May 2020.

Energy/Climate Change Assessment Division
Nam Hoon KIM



CERTIFICATE OF COMPETENCE

Name: Jin Seok CHO

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

- 1.1 Thermal energy generation
- 1.2 Renewables
- 5.2 Caprolactam, Nitric acid, Adipic acid
- 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 11 March 2019

Sustainability Management Institute

Mi Jung LEE

Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
1	Project participant	Monitoring report	Ver. 01.0 (13/04/2021) Ver. 02.0 (27/07/2021) Ver. 02.1 (10/09/2021)	Project participant
2	Project participant	Calculation spreadsheet of emission reductions	Ver. 01.0 (18/02/2021) Ver. 02.0 (27/07/2021) Ver. 02.1 (10/09/2021)	Project participant
3	Project participant	Temperature and pressure adjusted sheet Conservative calculation sheet	Ver. 01.0 (27/07/2021) Ver. 01.0 (10/09/2021)	Project participant
4	Project participant	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)	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)	https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/CP/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/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) https://cdm.unfccc.int/PRCContainer/DB/prcp315706268/view	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) https://cdm.unfccc.int/PRCContainer/DB/prcp691962865/view	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) https://cdm.unfccc.int/PRCContainer/DB/prcp423015635/view	Others
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 (Ref. No.:PRC-0922-004)	(02/01/2019) https://cdm.unfccc.int/PRCContainer/DB/prcp916230281/view	Others
11	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.	(06/01/2021) https://cdm.unfccc.int/PRCContainer/DB/prcp124981624/view	Others

		No.:PRC-0922-005)		
12	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	Version 01.0 (15/07/2021) Version 01.1 (10/09/2021)	Others
13	KFQ	CDM Verification Report_MP14	Ver. 01.1 (24/09/2020) https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/C/P/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/i/Process/KFQ1588147089.41/view	Others
14	KFQ	CDM Verification Report_MP13	Ver. 02.1 (15/11/2019) https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/C/P/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/i/Process/KFQ1554957772.32/view	Others
15	KFQ	CDM Verification Report_MP12	Ver. 02.0 (03/01/2019) https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/C/P/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/i/Process/KFQ1522302679.66/view	Others
16	KFQ	CDM Verification Report_MP11	Ver. 02.0 (19/07/2017) https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/C/P/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/i/Process/KFQ1479811523.59/view	Others
17	KFQ	CDM Verification Report_MP10	Ver. 02.0 (19/05/2016) https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/C/P/UIQG9RL4R8NOHIL560MP5QRBQN9MDC/i/Process/KFQ1442393803.37/view	Others
18	Hanwha Corporation	Construction completion report of switching location of DeN ₂ O unit	29/11/2016	Project participant
19	Hanwha Corporation	CDM Monitoring Manual of HWC	December 2018	Project participant
20	Hanwha Corporation	Organizational structure	From 12/01/2018 to 31/12/2020	Project participant
21	Hanwha Corporation	Daily operation report (excel files) - ABB logging file - DCS Event log files Summary shutdowns & observations	01/01/2020 ~ 31/12/2020	Project participant
22	Hanwha	Daily working log	04/04/2020	Project

	Corporation		10/04/2020 15/05/2020 16/05/2020 24/05/2020 13/08/2020 02/09/2020 03/09/2020 15/10/2020 11/11/2020 29/11/2020 19/12/2020	participan t
23	EMERSON	Product Data Sheet (Specifications of HNO ₃ flow meter)	PS-00374, Rev. AC (November 2015)	Project participan t
24	HWC	Purchasing inquiry of HNO ₃ flow meter (EMERSON)	03/01/2018	Project participan t
25	FMTech	Flow meter of HNO ₃ production - Calibration result on flow meter (FT-512)	31/01/2019 10/04/2020	Project participan t
26	Hanwha Corporation	Internal standard for testing HNO ₃	HWO-C-101 Version 01 (01/06/2005)	Project participan t
27	Hanwha Corporation	Daily analysis sheet of HNO ₃ concentration	01/01/2020~ 31/12/2020	Project participan t
28	UHDE	Operation manual - Technical standard for determination of HNO ₃ concentration	July 1992	Project participan t
29	Hanwha Corporation	Purchase record - Statement of transaction of specific gravity hydrometer	26/12/2019 29/01/2020	Project participan t
30	Hanwha Corporation	Purchase record - Statement of transaction of thermometer	22/11/2019 20/11/2020	Project participan t
31	Hanwha Corporation	Operation manual of Onsan plant	HWO-A-402 Rev.8 01/06/2018	Project participan t
31	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 participan t
33	Korea Instrument Co., Ltd	Flow meter at outlet of DeN ₂ O unit - Calibration result on Pressure Transmitter (PT-362)	03/01/2019	Project participan t
34	FM Tech Co., Ltd.	Flow meter at outlet of DeN ₂ O unit - Calibration result on Pressure Transmitter (PT-362)	02/04/2020	Project participan t
35	FM Tech Co., Ltd.	Flow meter at outlet of DeN ₂ O unit - Calibration result on Temperature Detector (TT-162)	02/04/2020	Project participan t
36	SGS Nederland BV	EN14181 QAL2 N ₂ O and flow measurements at the HWC outlet Nitric acid plant	18/09/2019~20/09/2019	Project participan t
37	SGS Nederland BV	EN14181 AST Validation N ₂ O measurements at HWC	28/10/2020~29/10/2020	Project participan t
38	Innotech	QAL 3 (Zero & Span test) - Calibration report (zero&span test)	01/01/2020~31/12/2020	Project participan t

		- N ₂ O analyser weekly check sheet		
39	Deokyang	Certificate of Analysis on Standard Gas - Zero gas - Span gas	22/05/2019 15/01/2020	Project participant
40	KMAR	ISO 9001:2015 Certificate, valid until 15/12/2023	05/11/2020	Project participant
41	Hanwha Corporation	Process Flow Diagram	13/11/2019	Project participant
42	SGS Nederland BV	Internal procedure for calibration frequency of QAL2 and AST	October 2017	Project participant
43	DURAG	Specification manual of Differential Pressure Transmitter	12 December 2015	Project participant
44	Hanwha Corporation	MoC Annex 2	05/04/2017 https://cdm.unfccc.int/Projects/DB/TUEV-SUED1170949600.29/view?cp=1	Project participant
45	Ministry of Environment	Clean Air Conservation Act of the Republic of Korea	From 15/01/2019 Published under: 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
46	Office for Government Policy Coordination	Framework Act on Low Carbon, Green Growth	From 31/12/2018 Published under: http://law.go.kr/lsInfoP.do?lsiSeq=206348&efYd=20190401#0000	Others
47	Ministry of Environment	Act on the Allocation and Trading of Greenhouse-gas Emission Permits	From 16/10/2018 Published under: http://www.law.go.kr/lsInfoP.do?lsiSeq=204823&efYd=20190117#0000	Others
48	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
49	CEN (European committee for Standardization)	EN14181 Stationary source emissions - Quality assurance of automated measuring systems	26/11/2014	Others
50	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	31/03/2013 https://cdm.unfccc.int/methodologies/DB/HKCO7RKOQO748WNXJND EW3BJT9XN8L 03/06/2011 https://cdm.unfccc.int/m	Others

		<p>gaseous steam, version 02.0</p> <p>Tool - Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion, version 02.0</p> <p>Standards, Procedures & Checklists</p> <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 – Guideline on the application of materiality in verifications (Version 02.0) 	<p>ethodologies/PAmethodologies/tools/am-tool-08-v2.pdf/history_view</p> <p>02/08/2008 https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf/history_view</p> <p>From 29/11/2018</p> <p>From 29/11/2018</p> <p>From 29/11/2018</p> <p>From 20/02/2015</p>	
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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.3	Date: 21/05/2021
Description of CL				
The verification team found missing event and errors in event end time and total duration as below in MR (version 01.0) -Event omission: 06:00~14:00 on 19/12/2020 -Typo of event end time: MR- 08:00 on 04/04/2020 /ER sheet-09:00 on 04/04/2020 -Typo of event total time: MR- 23 hours: 11/08/2020 23:00~13/08/2020 09:00/ER sheet-34 hours				
Project participant response				Date: 10/09/2021
PP checked the daily log sheet and revised MR and ER calculation sheet. And PP provided the daily log sheets as an evidence to the verification team				
Documentation provided by project participant				
-MR(version 2.1) -ER caculation sheet(version 2.1) -Daily log sheet				
DOE assessment				Date: 16/09/2021
The verification team has checked the evidences and confirmed that MR (version 2.1) and ER calculation sheet (version 2.1) are correctly revised.				

CL ID	02	Section no.	E.6.2	Date: 21/05/2021
Description of CL				
As for P _{production} , PP replaced the nitric acid flow meter on 10/04/2020 with new one of same model. However, replacement information (equipment serial number/ date of calibration/ validity) in the MR (version 01.0) is not consistent with the actual activity.				
MR	After 10/04/2020(installation date)	Serial number: 14506121 Date of calibration: 30/10/2020 Validity: 31/03/2022		
	Previous 10/04/2020	Serial number: 14675545 Date of calibration: 10/04/2020 Validity: 09/09/2021		
Actual activity	After 10/04/2020(installation date)	Serial number: 14675545 Date of calibration: 10/04/2020 Validity: 09/07/2021		
	Previous 10/04/2020	Serial number: 14506121 Date of calibration: 31/01/2019 Validity: 30/04/2020		
Project participant response				Date: 10/09/2021
PP provided the revised the MR (version 2.1) and described the replacement information of the measurement equipment according to the actual monitoring activities.				
Documentation provided by project participant				

-MR (version 2.1) -Daily working log on 04/04/2020	
DOE assessment	Date: 16/09/2021
The verification team confirmed the description of replacement information is consistent with the actual activities and correctly described in the MR (version 2.1).	

CL ID	03	Section no.	E.6.2	Date: 21/05/2021
Description of CL				
Validity of equipment in the MR (version 01.0) is not consistent with calibration frequency of them. -10-FT-562: Calibration frequency 12 months, latest calibration: 28~29/10/2020, validity: 27/10/2020 -10 PT-362: Calibration frequency 15month, latest calibration: 02/04/2020, validity: 01/09/2021 -10 TT-162: Calibration frequency 15month, latest calibration: 02/04/2020, validity: 01/09/2021 -NDIR analyser (10-AI-062) QAL3: 30/12/2019 (the date of last calibration in previous monitoring period)				
Project participant response				Date: 10/09/2021
PP submitted revised MR (version 2.1) and validity of equipment is modified in the basis of calibration frequency in the monitoring plan.				
Documentation provided by project participant				
-MR (Version 2.1)				
DOE assessment				Date: 16/09/2021
The verification team confirmed that validity of equipment is correctly indicated in MR (version 2.1).				

Table 3. CAR from this verification

CAR ID	01	Section no.	E.6.2	Date: 21/05/2021
Description of CAR				
The verification team found that AST was conducted on 29/10/2020. However, the duration between 18/09/2020 and 29/10/2020 was not complied with the monitoring plan, value of moisture content of the gaseous stream shall be determined as the mean value among three consecutive measurements perform in the same day (at least 2 hours each). -Applicable period of PRC-0922-005: 01/01/2019~17/09/2020 -AST: 28~29/10/2020 -Non-compliance duration: 18/09/2020~29/10/2020				
Project participant response				Date: 10/09/2021
PP decided to request for approval of proposed monitoring plan temporarily deviated from the registered monitoring plan for $\text{CH}_2\text{O}_{t,db,n}$ to reflect actual monitoring result				
Documentation provided by project participant				
-Temporary deviation explanation(version 04.0, 15/07/2021)				
DOE assessment				Date: 16/09/2021
KFQ confirms this temporary deviation complies with the relevant requirements related to temporary deviation from the registered monitoring plan in the 'CDM project standard for project activities (version 02.0). Please refer PRC validation report (version 01.0, 15/07/2021) for further details.				

CAR ID	02	Section no.	E.6.2	Date: 21/05/2021
Description of CAR				

Value of monitored parameters is not consistently provided in the MR(version 01.0) with it in ER calculation (version 01.0) as follows:

	MR(ver 1.0)	ER calculation sheet (ver 1.0)
P _{production,y}	120,837	120,576
h _{r,y}	0	2
h _y	8,333	8,333 But it can be 8,357 including un-checking hours (22:00~23:00 on 15/05/2020, 05:00~06:00 on 16/05/2020 and 15:00~23:00 on 11/11/2020)
V _{t,db}	375,679,309	394,003,634
V _{i,t,db}	7.93 x 10 ⁻⁵	6.97 x 10 ⁻⁵

Project participant response**Date:** 10/09/2021

PP submitted revised ER calculation sheet (version 2.1) and MR (version 2.1) with relevant evidences.

Documentation provided by project participant

- MR (version 2.1)
- ER calculation sheet (version 2.1)
- Raw data
- Daily log sheets

DOE assessment**Date:** 16/09/2021

The verification team checked the value in the MR and ER calculation sheet and concluded that parameters are correctly reflected in the ER calculation (version 2.1) and indicated in MR (version 2.1).

CAR ID	03	Section no.	E.6.2	Date:	21/05/2020
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Description of CAR

As for delayed calibration of Absolute Pressure Transmitter and Resistance Temperature Detector,

- A. PP did not clearly identify these data is affected which parameter, V_{t,db} or V_{i,t,db}
- B. PP applied a maximum permissible error, even though the calibration result is beyond the maximum permissible error of the equipment

Project participant response**Date:** 10/09/2021

PP adjusted the value of V_{t,db} applying the error identified in the delayed calibration test (1% of Residence temperature detector and 0.8% of Absolute pressure transmitter) in the delayed calibration according to VVS article 366 (b). And PP submitted the revised MR(version 2.1) and ER calculation sheet(version 2.1) to reflex the adjusted values.

Documentation provided by project participant

- MR (version 2.1)
- ER calculation sheet (version 2.1)
- Conservative calculation sheet (1.0)

DOE assessment**Date:** 16/09/2021

The verification team checked calibrations reports and found out that the error identified in the delayed calibration test is 1% of Residence temperature detector and 0.8% of Absolute pressure transmitter respectively and these values are beyond the maximum permissible error of the equipment. Moreover, the verification team reviewed how to calculated V_{t,db} applying the adjusted values in Conservative calculation sheet (version 01). Specification manual of Differential Pressure Transmitter (D-FL-100, manufacturer: DURAG) is described calculation formula of volumetric flow. The equation and relevant parameters are explained in the specification manual and this calculation formula is consistently applied in Conservative calculation sheet (version 01). Adjustment of V_{t,db} is also calculated conservatively. Please refer to "Conservative calculation sheet" for details.

The verification team confirms that the measured values of the instrument during the delayed calibration period are correctly recalculated by applying the error identified in the delayed calibration test as per the requirement, article 366 (b) of VVS (version 02.0).

Table. FAR from this verification

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	

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
04.0	6 April 2021	Revision to: <ul style="list-style-type: none"> • Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR).
03.0	31 May 2019	Revision to: <ul style="list-style-type: none"> • Ensure consistency with version 02.0 of the “CDM validation and verification standard for project activities” (CDM-EB93-A05-STAN); • Make structural and editorial improvements.
02.1	11 January 2018	Editorial revision to correct the numbering of appendices in the instructions.
02.0	31 October 2017	Revision to align with the requirements of the “CDM validation and verification standard for project activities” (version 01.0).
01.0	23 March 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: project activities, verifying and certifying		