




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

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

BASIC INFORMATION

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| Title and UNFCCC reference number of the project activity | <ul style="list-style-type: none"> Title: Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp. Reference number: 0765 |
| Version number of the verification and certification report | <ul style="list-style-type: none"> Version 01.2 |
| Completion date of the verification and certification report | <ul style="list-style-type: none"> 21/09/2018 |
| Monitoring period number and duration of this monitoring period | <ul style="list-style-type: none"> Monitoring period number : 38th (12th monitoring period in the 2nd crediting period) Duration : 07/05/2018 – 05/08/2018 |
| Version number of the monitoring report to which this report applies | <ul style="list-style-type: none"> Version 01.1 |
| Crediting period of the project activity corresponding to this monitoring period | <ul style="list-style-type: none"> From 22/01/2014 to 21/01/2021 |
| Project participants | <ul style="list-style-type: none"> Carbon CDM Korea Ltd. Hu-Chems Fine Chemical Corp. RWE Power AG Carbon Climate Protection GmbH |
| Host Party | <ul style="list-style-type: none"> Republic of Korea |
| Applied methodologies and standardized baselines | <ul style="list-style-type: none"> Applied methodology : ACM0019 (version 02) (N₂O abatement from nitric acid production) No standardized baseline(s) applicable |
| Mandatory sectoral scopes linked to the applied methodologies | <ul style="list-style-type: none"> Sectoral scope: 5-Chemical industries |
| Conditional sectoral scope(s) linked to the applied methodologies | <ul style="list-style-type: none"> No conditional sectoral scope(s) linked to the applied methodology |
| Estimated amount of GHG emission reductions or GHG removals for this monitoring duration in the registered PDD | <ul style="list-style-type: none"> Amount estimated in PDD for 2018: 1,231,777 tCO₂e → Corresponding estimated amount for the duration of the monitoring period (91 days): 307,101 tCO₂e |
| Certified amount of GHG emission reductions or GHG removals for this monitoring period | <ul style="list-style-type: none"> 305,079 tCO₂e |
| Name and UNFCCC reference number of | <ul style="list-style-type: none"> Name: Korean Foundation for Quality (KFQ) Reference number: E-0025 |

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| the DOE | |
| Name, position and signature of the approver of the verification and certification report | Soon Hong YEOM  Managing Director of Sustainability management institute |

SECTION A. Executive summary

CARBON Climate Protection GmbH has commissioned Korean Foundation for Quality (KFQ) to carry out the verification and certification of emission reductions reported for the “Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” in the Republic of Korea (the project) in the period from 07/05/2018 to 05/08/2018. 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 destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” for the period from 07/05/2018 to 05/08/2018 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 the 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 02.0), 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 MR on the UNFCCC CDM website have been used as a basis for conclusion of verification.

The verification process includes desk review of the MR published (and any updated versions, if available), emission reduction calculation spreadsheets 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 draft 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 draft verification report is prepared. The draft verification report reviewed by a technical reviewer according to KFQ's internal quality assurance procedures. If no further findings are raised the final verification report is prepared and reviewed once again.

The data presented in the MR were assessed by review of the detailed project documentation and production records, as well as by interviews with personnel at Hu-Chems, CARBON CDM Korea Ltd. and Carbon Climate Protection GmbH, 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

| | |
|---|---|
| Project Parties | Republic of Korea (Host) Germany Austria |
| Title of project activity | Catalytic N ₂ O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp. |
| UNFCCC Reference Number | 0765 |
| Project Participants | Hu-Chems Fine Chemical Corp. (Korea) CARBON CDM Korea Ltd. (Korea) RWE Power AG (Germany) Carbon Climate Protection GmbH (Austria) |
| Baseline and monitoring methodology | ACM0019 (Version 02) |
| Location of the project activity | Address Yeosu, 7-6, Wollae-dong, Jeollanam-do, Republic of Korea GPS Coordinates: Longitude: 127.743198E // Latitude: 34.848686N |
| Registration Date | 22/01/2007 |
| Registered PDD (2 nd crediting period) | Version 4.2 of 18/12/2017 |
| Validation (2 nd crediting period) | Validation report of 07/11/2013 by TUEV Nord |
| Renewal date | 05/02/2014 |
| 2 nd Crediting Period | 22/01/2014 to 21/01/2021 |
| Period verified in this verification | 07/05/2018 to 05/08/2018 |

The project has installed tertiary N₂O reduction technology in the tail gas stream of the three nitric acid production plants of Hu-Chems Fine Chemicals Corp. (hereafter called "Hu-Chems") in Yeosu, Korea. Nitrous oxide, formed as a by-product of the nitric acid production, is removed by three EnviNOx® Systems provided by UHDE GmbH.

In plant II and III each EnviNOx® system comprises one reactor with two catalyst beds. Nitrogen oxides (NO_x) and nitrous oxide (N₂O) are simultaneously catalytically reduced in the first bed by using the reducing agents ammonia and propane, respectively. In the second bed carbon monoxide is oxidised to carbon dioxide. The additional GHG emission from the use of propane is monitored and considered in the calculation of emission reduction. The existing selective catalytic reduction (SCR) reactors are still operating.

In plant IV the system also contains two catalyst beds arranged in series. The first bed reduces N₂O by catalytic decomposition (no use of hydrocarbons) while in the second bed NO_x is reduced

with ammonia and some further reduction of N₂O takes place. Other than in plant II and Plant III, the SCR reactor existing prior to project implementation in plant IV has been removed here, as it was described in the registered PDD.

The tail gas from the nitric acid facility is fed into EnviNOx® Systems, and according to the ex-ante emission reductions in the PDD, the nitrous oxide is reduced by approximately 97%.

The tail gas volume flow and the nitrous oxide concentration at the outlet of the EnviNOx® System are monitored and recorded. The propane used in the catalytic reduction is monitored in order to calculate the non-N₂O project emissions of the project activity (whereas propane gas is applied in the EnviNOx® System of Plant II and III but not in plant IV, as it was described in the PDD).

Conclusion

KFQ has performed the verification of the emission reductions reported for the project activity “Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” in the republic of Korea (UNFCCC Registration Ref. No. 0765) for the period from 07/05/2018 to 05/08/2018.

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 EnviNOx® System and records from the production logs of the nitric acid production have been examined and verified for the reporting period.

The verification team has during its preparations identified the key reporting risks and used the assessment to determine to which extent the project operator’s control systems were adequate for mitigation of these key reporting risks. In addition, other areas that can have an impact on reported emission reductions have also undergone detailed audit testing.

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

The implementation of the project resulted in 305,079 tCO₂e of emission reductions during the period from 07/05/2018 to 05/08/2018 which is within the renewable, second crediting period from 22/01/2014 to 21/01/2021. In our opinion, the GHG emission reductions reported for the project in the MR (Version 01.1) 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 Project Design Document of version 4.2 dated 18/12/2017.

KFQ is able to certify that the emission reductions from the “Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” in Korea during the period from 07/05/2018 to 05/08/2018 amount to 305,079 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 review | On-site inspection | Interview(s) | Verification findings |
| 1. | Team Leader | IR | CHO | Jin Seok | KFQ | √ | √ | √ | √ |
| 2. | Verifier (*) | IR | LEE | Mi Jung | 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 | JEONG | Yu Sim | KFQ |
| 2. | Approver | IR | YEOM | Soon Hong | KFQ |

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

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

| No. | Risk that could lead to material errors, omissions or misstatements | Assessment of the risk | | Response to the risk in the verification plan and/or sampling plan |
|-----|---|------------------------|---|--|
| | | Risk level | Justification | |
| 1 | Number of Monitoring parameters | L | Methodology and tool require a rather low number of monitoring parameters | In response of that risk, the KFQ verification team nevertheless included two verifiers in total and two of them on-site in order to cover/review all monitoring parameters in a complete and detailed manner. |
| 2 | Error rate in Monitoring report | L | Expert organization is involved in compilation of MR as well as calculation | In response of that risk, the KFQ verification team focused on systematic consistency and error checks. |
| 3 | Familiarity with Monitoring system | L | This is 38 th monitoring period (12 th period of second crediting period). Expert organization is involved in the periodic inspection of monitoring equipment | In response to that risk, the KFQ verification team checked the existence of any and all monitoring instruments as well as their valid calibration, independently from the fact that the PPs would be familiar with the monitoring system. |
| 4 | QA/QC | L | Stable QA/QC system has | In response to that risk, the |

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| | | | <i>been implemented and integrated into existing QMS. QA/QC required by EN 14181 is also well implemented introduced.</i> | <i>KFQ verification team focused on periodic calibration and QA/QC activities performed as per EN 14181 as well as on plausibility check in order to ensure data quality.</i> |
| 5 | <i>Data flow</i> | <i>L</i> | <i>Transmitted to the spreadsheet automatically</i> | <i>In response to that risk, the KFQ verification team checked the safeguard measures for raw data and crosschecked raw data with the MS Excel spreadsheets on a random sampling basis, in an extent to ensure the functioning of the transferring system.</i> |
| 6 | <i>Recalculation</i> | <i>M</i> | <i>Calculation is performed in excel spreadsheet applying formulae. However, recalculation is done manually.</i> | <i>In response to that risk, the KFQ verification team firstly checked on the existence of omissions of events for recalculations and secondly reviewed all recalculations in detail.</i> |

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 them. KFQ planned the verification by obtaining evidence and other information and explanations that KFQ considers necessary to give reasonable assurance on the reported GHG emission reductions on the basis of risk level identified and materiality concept in accordance with "Guideline of application of materiality in verifications (ver. 02)".

C.2. Consideration of materiality in conducting the verification

There were two detected findings they do not impact the amount of emission reductions. 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 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 01.0 dated 17/08/2018, published on 21/08/2018) and the CDM Project 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 post-registration changes to project activities and Checklist for requests for issuance for project activities and relevant decisions, clarifications and guidance from the CMP and the CDM EB.

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

- Verify the compliance of the MR with the guidance for completing the monitoring report form;
- Verify the completeness of the data and the information presented;

- Review the monitoring plan and monitoring methodology. Check the compliance of the MR with respect to the monitoring plan and verify that the applied methodology was carried out. Particular attention to coverage of all monitoring parameters, the frequency of measurements, the quality of the metering equipment including calibration requirements and the quality assurance and quality control procedures was paid;
- Review the calculations and assumptions used to obtain GHG data and ER
- Evaluate the data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

D.2. On-site inspection

Detailed verification of all data contained in the MR was performed during the site visit at Hu-Chems Fine Chemicals Corp. on 13/09/2018. During the site visit, the personnel were interviewed or assisted the verification team. During the on-site assessment, KFQ has applied standard auditing techniques to assess the quality of information provided. The following aspects of the CDM project activity have been confirmed:

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

Further, the following activities were performed:

- A cross-check between information provided in the MR and data from other sources such as plant log books, inventories, purchase 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: 13/09/2018 | | | | |
|--|---|---------------|------------|-----------------------------|
| No. | Activity performed on-site | Site location | Date | Team member |
| 1 | Confirmation of the correct & complete implementation and operation of the Project Activity and check of all physical features as described in the PDD are in place. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |
| 2 | Review of the complete data flow from data generation, aggregation, recording, calculation to reporting of the monitoring parameters. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |
| 3 | Confirmation of the complete & correct implementation of procedures for the operation and data collection. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |
| 4 | Verification of the information provided in the MR and documentation with other sources. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |
| 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. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |
| 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. | Yeosu | 13/09/2018 | Jin Seok CHO Mi Jung LEE |

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 | HAN | Du Hee | Hu-Chems Fine Chemicals Corp | 13/09/2018 | General support | Jin Seok CHO Mi Jung LEE |
| 2 | LEE | Seung hun | Same as above | 13/09/2018 | General support, Maintenance | Jin Seok CHO Mi Jung LEE |
| 3 | KIM | Jin sung | Same as above | 13/09/2018 | Production, Documentation | Jin Seok CHO Mi Jung LEE |
| 4 | BAEK | Jong Min | Same as above | 13/09/2018 | General support, Maintenance | Jin Seok CHO Mi Jung LEE |
| 5 | KIM | Dong Hyun | Carbon CDM Korea | 13/09/2018 | CDM Coordination | Jin Seok CHO Mi Jung LEE |
| 6 | Bichler | Sonja | Carbon Climate Protection GmbH | 13/09/2018 | QA/QC, Calculation, Reporting | Jin Seok CHO Mi Jung LEE |

D.4. Sampling approach

As per the requirements set out in CDM Validation and Verification Standard for Project Activity (Version 01.0), 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. Sampling plan when the

verification team planned for verification needed not to be revised as no omissions in the detection process of events related to emission reductions were found.

Whereas 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 | 0 | 0 | 0 |
| Post-registration changes | 0 | 0 | 0 |
| Compliance of the registered monitoring plan with the methodologies including applicable tools and standardized baselines | 0 | 0 | 0 |
| Compliance of monitoring activities with the registered monitoring plan | 0 | 0 | 0 |
| Compliance with the calibration frequency requirements for measuring instruments | 0 | 0 | 0 |
| Assessment of data and calculation of emission reductions or net removals | 0 | 0 | 0 |
| Assessment of reported sustainable development co-benefits | 0 | 0 | 0 |
| Global stakeholder consultation | 0 | 0 | 0 |
| Others (please specify) | 2 | 0 | 0 |
| - Typo error regarding event occurred | | | |
| - Insufficient explanation regarding event occurred | | | |
| Total | 2 | 0 | 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 deviations from the provisions of a registered/revised plan and/or methodology and iii) the data and calculation of GHG emission reductions are correct.

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

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

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.

2 CLs were raised for this monitoring period, which were closed after the PP satisfactorily addressed them in the revised MR version 01.1.

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

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| Means of verification | KFQ has checked the MR provided by the PP against the latest MR form in order to determine, whether the MR is in compliance with it. |
| Findings | It was found that there are no deviations between the MR and the latest monitoring report form (version 06.0). |
| Conclusion | The verification team concludes that the MR (version 01.0 and 01.1) are in compliance with the latest monitoring report form (Version 06.0) and the instructions therein. |

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

There was a forward action request (FAR) raised from the validation for renewal of crediting period and no FAR was raised from previous verification. The FAR was sufficiently addressed by the PPs. Please refer to Appendix 4 of this report for more details with regard to the FAR from validation.

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

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|------------------------------|---|
| Means of verification | <p>Physical project implementation During the on-site visit, the KFQ verification team visually inspected the installations of the EnviNOx® systems 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 (version 4.2 dated 18/12/2017). Also, the KFQ verification team reviewed the documentation in respect of start-up and operation of the EnviNOx® systems, monitoring instrument specifications including containing details such as instrument history and measuring ranges.</p> <p>Project operation The verification team checked the operational records and other relevant information (Appendix 3) and interviewed relevant plant staff on the actual operation of the nitric acid plants and the EnviNOx® systems. Also daily reports, event log files, service reports, maintenance & calibration reports, DeltaV curves and detecting process of events were checked by the KFQ verification team, especially with regard to times with shutdowns and special events, as indicated in the MR.</p> <p>Management system and quality control and quality assurance The operation procedures and QA/QC procedures and respective reports have been reviewed and crosschecked by the KFQ verification team. Furthermore, the latest organizational arrangements were checked by means of interviews with relevant staff from Hu-Chems Fine Chemical Corp. (hereinafter referred to as "Hu-Chems") and Carbon Climate Protection GmbH (hereinafter referred to as "CARBON").</p> <p>Consecutive monitoring period The verification team checked monitoring period of previous verifications through interviews with staff from Hu-Chems and CARBON as well as history of requests for issuance provided by UNFCCC website to confirm consecutive monitoring periods of this project activity.</p> |
| Findings | <p>Physical project implementation The project covers three nitric acid plants (three EnviNOx® systems, respectively). The EnviNOx® system at Hu-Chems IV was installed in December 2006, at II and III were installed in February and March 2007 respectively. The starting dates of operation of the project activity, with putting all physical features and data collection systems and storage in place, for each of the plants were as follows.</p> <ul style="list-style-type: none"> • Hu-Chems nitric acid plant IV: 09/01/2007 • Hu-Chems nitric acid plant II : 26/03/2007 |

- Hu-Chems nitric acid plant III: 29/03/2007

The implementation status of the project activity was the same during the monitoring period and found to be in accordance with the relevant documentation.

Project operation

The nitric acid plants II, III and IV as well as their EnviNOx® systems were in normal operation except during the downtimes as mentioned in the MR. In case of the nitric acid plant IV, there was no shutdown thus the plant and its EnviNOx® system were in normal operation during whole monitoring period.

The KFQ verification team can confirm that during these downtimes, no emission reductions were claimed by the PPs.

Operation of 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 MR 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.

During the site visit it was found through interview with staff and sample review of trend curves for raw data that all operational events were reported on the MR completely. However, according to the operational records such as daily report, CDM charts and ER calculation spreadsheet of Hu-Chems II, NA plant shutdown period during this monitoring period is from 03:00 on 20/05/2018 to 21:00 on 20/05/2018 but it was wrongly stated in section B.1 of the MR (v.01.0). (Refer to Appendix 4/Table 2/CL ID 01). Moreover, reason of N₂O fluctuation on 29/06/2018 of Hu-Chems IV wasn't clearly explained in the MR (v.01.0). (Refer to Appendix 4/Table 2/CL ID 02). After the PPs have submitted the MR (V.01.1), correct shutdown period of Hu-Chems II, NA plant shutdown during this monitoring period and clear explanation on reason of N₂O concentration fluctuation of Hu-Chems IV from 13:00~16:00 on 29/06/2018 were provided in the revised MR.

Management system and Quality assurance

KFQ found that the project is operated and monitored by Hu-Chems Fine Chemical Corp. (Hu-Chems), responsibility for checking & reporting of data under the CDM activity has been contracted to CARBON CDM Korea Ltd. and CARBON. The procedures & responsibilities are described in the MR and are considered and applied in full. With respect to quality control and quality assurance, the KFQ verification team found that the EnviNOx systems and the monitoring systems are designed as an automatic process, so the involvement of the personnel during normal operation is minimised. In case of any deficiency, appropriate procedures are in place. The MR includes a detailed description of the periodical observations of the EnviNOx systems and the monitoring instruments, in case of failures responsibilities are defined.

It has been found that a service agreement is in place for the analyser system and the DeltaV system between Hu-Chems and Emerson Process Management Korea Ltd. The contract covers regular preventive checks on operational condition of the analyser system (on a monthly basis), "On site" DeltaV system health checks (on a monthly basis), 24 hour emergency service, inspections visits (on a quarterly basis) and respective reporting. Service reports of performed maintenance activities, calibrations and checks and other service reports (where applicable) were made available for verification and were found to be complete & suitable. Data handling solutions involve redundancy check, data manipulation protection, integrity check as well as archiving and were also found to be suitable. Safeguarding procedures in accordance to the monitoring plan have been applied in a conservative way.

KFQ found that the quality assurance and quality control procedures in terms of equipment operation, maintenance, calibration as well as data reporting are covered by project operator's management system which is certified to comply with ISO 9001:2009 and ISO 14001:2009, certification has found to be valid during the whole monitoring period. Hu-Chems covers all CDM activities in the internal,

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| | <p>external audit and management reviews.</p> <p>It was found that local operators and instrumentation engineers of the system have been trained by the equipment suppliers. The related procedures were kept on site and were easily available.</p> <p>Consecutive monitoring period</p> <p>This is the 38th monitoring period since registration of this project activity. Previous 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 confirm monitoring periods of this project have been consecutive.</p> |
| Conclusion | <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 MR 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 MR and in accordance with the registered PDD. • The monitoring periods of this project have been consecutive. <p>The raised CLs (ID 01 and ID 02) have been completely resolved.</p> |

E.4. Post-registration changes

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

There were no temporary deviations applied to this monitoring period.

E.4.2. Corrections

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

However, there was correction during 35th verification as below and it was approved on 09/03/2018:

- Measurement method of moisture content of the gaseous stream at normal condition ($C_{H_2O,t,db,n}$) of Hu-Chems II, III and IV
- Tag number of temperature transmitter for measuring Nitric acid production of Hu-Chems IV

Except above mentioned correction, project participant's information is updated. Please kindly refer to registered PDD (version 4.2, 18/12/2017) for above corrections.

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

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

E.4.4. Inclusion of a monitoring plan

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

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

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

E.4.6. Changes to the project design

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

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

N/A

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

| | |
|------------------------------|--|
| Means of verification | The KFQ verification team reviewed the monitoring plan contained in the registered PDD against the approved methodology, ACM0019 (Version 02), "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3) and "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (Version 2) which is applied by the project activity. |
| Findings | The KFQ verification team found that there are no incompliances between the applicable monitoring plan, the applied methodology ACM0019 (Version 02), "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3) and "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (Version 2). Furthermore it was found that there are no standardized baselines applied in the project activity. |
| Conclusion | KFQ confirms that the monitoring plan is in accordance with the approved methodology, ACM0019 (Version 02), "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3) and "Tool to calculate project or leakage CO ₂ emissions from fossil fuel combustion" (Version 2) applied by the project activity (no standardized baselines are used in the project activity). |

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

General statement on data and parameters

| | |
|------------------------------|---|
| Means of verification | The means of verification in relation to the different parts (Information flow and data collection system, monitoring parameters and Social Fund) are stated in detail in the section & tables further below. |
| Findings | The findings in relation to the different parts (Information flow and data collection system, monitoring parameters and Social Fund) are stated in detail in the section & tables further below. |
| Conclusion | <p>KFQ confirms that the monitoring is complete and has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. The monitoring plan has been properly implemented and is followed by the PPs.</p> <p>KFQ confirms that all parameters stated in the monitoring plan have been monitored and updated as applicable, including project emission parameters, baseline emission parameters (leakage is not applicable) and management and operational system: the responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in the monitoring plan.</p> <p>KFQ confirms that the equipment used for monitoring is controlled and calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that monitoring results are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that QA/QC procedures have been applied in accordance with the monitoring plan.</p> |

| | |
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| | <p>KFQ confirms that the MR lists each parameter required by the monitoring plan and the information flow (i.e. from data generation, aggregation, recording, calculation and reporting) for these parameters is provided in the MR (The information flow for each parameter is further verified in the following sections).</p> <p>KFQ confirms that the monitoring methodologies and sustaining records are sufficient to enable verification of emission reductions.</p> |
|--|---|

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

| | | | | |
|------------------------------|---|---|--|---|
| Means of verification | Data and parameters fixed ex-ante as listed in the MR have been crosschecked & reviewed – as applicable – against the monitoring plan in the registered PDD as well as against the applied methodology (ACM0019 – Version 02) and other relevant CDM related documentation. | | | |
| Findings | <i>Data & Parameters fixed ex-ante and COMMONLY relevant for all three plants:</i> | | | |
| | Data/parameter (unit) | Source of data | Value(s) applied | KFQ Findings |
| | EF _{new,y} Baseline N ₂ O emission factor for nitric acid production in year y (related to 100 per cent pure acid) (kg N ₂ O/t HNO ₃) | PDD/ACM0019 (Version 02) | 2.80 | Crosscheck of the value with the registered PDD & Monitoring plan and the applied methodology showed compliance of parameter. |
| | GWP _{N2O} Global warming potential of N ₂ O (t CO ₂ e/t N ₂ O) | Relevant decision by the CMP & according to the registered PDD / ACM0019 (Version 02) | 298 | Value is correctly applied & justified and has been determined in accordance with the provisions of the CDM project standard, the PDD and ACM0019 (Version 02). |
| | <i>Data & Parameters fixed ex-ante and ONLY relevant for plant Hu-Chems II:</i> | | | |
| | Data/parameter (unit) | Source of data | Value(s) applied | KFQ Findings |
| | Operating pressure II Operating pressure of ammonia burner of Hu-Chems II (kPa) | PDD | 872 | Crosscheck of the value with PDD & monitoring plan showed compliance of parameter |
| | EF _{historical,II} Historical baseline emission factor of the nitric acid plant of Hu-Chems II (kg N ₂ O/t HNO ₃) | PDD | 12.09 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| | EF _{default,II} Default emission factor according to the operating procedure of the ammonia burner in year y (related to 100 percent pure acid) of Hu-Chems II (kg N ₂ O/t HNO ₃) | PDD/ACM0019 (Version 02) | 11.60 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| | P _{product, max,II} Design capacity of nitric acid production during the first crediting period of Hu-Chems II (tHNO ₃) | PDD | 116,800 (29,120 for this monitoring period) | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| | <i>Data & Parameters fixed ex-ante and ONLY relevant for plant Hu-Chems III:</i> | | | |
| | Data/parameter (unit) | Source of data | Value(s) applied | KFQ Findings |
| | Operating pressure III Operating pressure of | PDD | 872 | Crosscheck of the value with PDD & monitoring plan |

| | | | |
|--|--------------------------|---|---|
| ammonia burner of Hu-Chems III (kPa) | | | showed compliance of parameter |
| EF_{historical,III} Historical baseline emission factor of the nitric acid plant of Hu-Chems III (kg N ₂ O/t HNO ₃) | PDD | 11.26 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| EF_{default,III} Default emission factor according to the operating procedure of the ammonia burner in year y (related to 100 percent pure acid) of Hu-Chems III (kg N ₂ O/t HNO ₃) | PDD/ACM0019 (Version 02) | 11.60 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| P_{product, max,III} Design capacity of nitric acid production during the first crediting period of Hu-Chems III (tHNO ₃) | PDD | 116,800 (29,120 for this monitoring period) | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |

Data & Parameters fixed ex-ante and ONLY relevant for plant Hu-Chems IV:

| Data/parameter (unit) | Source of data | Value(s) applied | KFQ Findings |
|--|--------------------------|--|---|
| Operating pressure IV Operating pressure of ammonia burner of Hu-Chems IV (kPa) | PDD | 335 | Crosscheck of the value with PDD & monitoring plan showed compliance of parameter |
| EF_{historical,IV} Historical baseline emission factor of the nitric acid plant of Hu-Chems IV (kg N ₂ O/t HNO ₃) | PDD | 5.70 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| EF_{default,IV} Default emission factor according to the operating procedure of the ammonia burner in year y (related to 100 percent pure acid) of Hu-Chems IV (kg N ₂ O/t HNO ₃) | PDD/ACM0019 (Version 02) | 7.40 | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |
| P_{product, max,IV} Design capacity of nitric acid production during the first crediting period of Hu-Chems IV (tHNO ₃) | PDD | 467,200 (116,480 for this monitoring period) | Crosscheck of the value with the PDD & monitoring plan showed compliance of parameter |

Parameters from the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (Version 03.0.0)" COMMONLY relevant for all three plants:

| Data/parameter (unit, description) | Source of data | Value(s) applied | Assessment |
|--|--|------------------|--|
| R_u Universal ideal gases constant (Pa.m ³ /kmol.K) | PDD/ Tool to determine the mass flow of a greenhouse gas in a gaseous stream | 8,314 | Crosscheck of the value with the PDD and the applied methodological tool showed compliance of parameter. |
| MM_i Molecular mass of greenhouse gas i | PDD /Tool to determine the mass flow of a | 44.02 | Crosscheck of the value with the PDD and the applied methodological |

| | | | | |
|-------------------|--|--|---------|--|
| | (kg/kmol) | greenhouse gas in a gaseous stream | | tool showed compliance of parameter. |
| | P_n Total pressure at normal conditions (Pa) | PDD/ Tool to determine the mass flow of a greenhouse gas in a gaseous stream | 101,325 | Crosscheck of the value with the PDD and the applied methodological tool showed compliance of parameter. |
| | T_n Temperature at normal conditions (K) | PDD/ Tool to determine the mass flow of a greenhouse gas in a gaseous stream | 273.15 | Crosscheck of the value with the PDD and the applied methodological tool showed compliance of parameter. |
| Conclusion | <p>KFQ confirms that all data and parameters fixed ex ante or at the renewal of the crediting period, such as emission factors, etc. are explicitly mentioned in the MR and have been correctly and consistently applied.</p> <p>All values are in compliance with relevant documentation such as the PDD & monitoring plan as well as the applied methodology, applied tools and other CDM related documentation, where applicable.</p> | | | |

E.6.2. Data and parameters monitored

Information flow & data collection system

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|------------------------------|--|
| Means of verification | <p>The KFQ verification team assessed the information flow and data collection system and by means of physical inspection of all major components of the information flow & data collection system as well as related documentation. Interviews with relevant staff were held in order to experience the system in action. Furthermore, the verification of the information flow (where applicable) for all monitoring parameters was successfully done by means of following documents and cross checks:</p> <p><i>Data generation and aggregation:</i></p> <ul style="list-style-type: none"> • Calibration records and certificates • Monthly Health Check reports • Quarterly Inspection Check Reports • General Maintenance service reports • Plausibility of tail gas flow volume flows with ex-ante values in the PDD • Monthly Emerson Service Reports, confirming the functionality of the data transmission system for all instruments • Certificate of analysis of the standard test gas for analyser calibration • Intervals (measuring frequency, reading frequency and recording frequency) of instruments for each instrument are also verified through display panel on-site and DCS generated <p><i>Aggregation to recording:</i></p> <ul style="list-style-type: none"> • Monthly Emerson Service Reports, confirming the functionality of the data storage system for all instruments • Data cross check between values from analysers/transmitters and values in control room & • Data cross check between DeltaV Trend curves (directly generated from raw data) and DeltaV Reports <p><i>Calculation and reporting:</i></p> <ul style="list-style-type: none"> • Crosscheck of implemented calculations in Excel sheets against the PDD formulae • Data cross check between DeltaV Report, production reports, and Excel Sheets |
| Findings | <p>As stated in the MR and verified by the KFQ verification team, common data flow systems are used in the project activity for the following parameters:</p> <ul style="list-style-type: none"> • Nitric acid produced ($P_{\text{production,y}}$) • Operating parameters of the nitric acid plants (NH_3 flow to AOR for |

| | |
|-------------------|---|
| | <p>determining h_y)</p> <ul style="list-style-type: none"> • Volumetric flow of the gaseous stream ($V_{t,db}$) • Volumetric fraction of N_2O in the gaseous stream ($v_{i,t,db}$) • Quantity of hydrocarbon ($FC_{i,j,y}$) for plants Hu-Chems II and III only <p>KFQ also verified that the instrument transmitters continuously provide an analogue signal to I/O cards and the signals are collected by a DCS Processor (DeltaV, respectively). 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. DCS System (DeltaV, respectively) also generates aggregated daily reports based on the raw data stored at the delegated server. Data are digitally transferred to the Excel sheets, where calculations of emission reductions are performed.</p> <p>It was found by the KFQ verification team, that the information flow & data collection system are fully functional and were so during the whole verification period covered under this verification. Respective documents and results were made available to KFQ for verification.</p> |
| Conclusion | <p>The KFQ verification team confirms that the information flow & data collection system meets the requirements of the registered PDD and its monitoring plan as per the applied and approved methodology, ACM0019 (Version 02) as well as the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0.0) and the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 03.0). Intervals (measuring frequency, reading frequency and recording frequency) are applied in accordance with the applied methodology, the above mentioned tools and the monitoring plan.</p> |

Assessment on data/ parameters

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

The table out of the CDM-VCR-FORM has been used for the assessment, following rows as needed have been added: Data/Parameter, Unit, Description, Source of data used, Value(s)

Plant specific parameters: Hu-Chems II

| | |
|------------------------------|---|
| Data/Parameter | P_{production,y,II} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems II |
| Source of data used | Production reports |
| Value(s) | 24,470 |
| Means of verification | <p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. The verification team checked the DCS daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR. 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 flow and density are measured with a mass flow meter, temperature with a temperature measurement and concentration is automatically determined based on measured parameters. Values are sent to the DCS (control room), and the nitric acid production (as 100% HNO₃) is calculated based on mass flow and HNO₃ concentration. Final production values are exported in production reports through the DeltaV System. Data from the DeltaV daily reports are digitally</p> |

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|-------------------|---|
| | <p>transferred to spreadsheets where emission reduction calculations are performed. There were no errors found in the digital transfer of data from the DeltaV daily reports to the spreadsheets.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p> |

| | |
|------------------------------|---|
| Data/Parameter | $h_{y,II}$ |
| Data Unit | h |
| Description | Number of hours of operation in year y of Hu-Chems II |
| Source of data used | Measuring device |
| Value(s) | 2,091 |
| Means of verification | <p>As per the PDD, the flow of NH_3 to the ammonia oxidation reactor indicates the operational status. In case, the volume flow of NH_3 to the ammonia oxidation reactor lies above the threshold of 500 Nm^3/h during an hour, the reactor is considered in normal 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 respective monitoring plan.</p> <p>The KFQ verification team also checked, whether the monitoring activities in relation to the volume flow to the AOR 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 daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Location of instrument, coriolis flowmeter, for measuring the NH_3 flow to the AOR has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found that the determination of the parameter based on measured values (i.e. whether NH_3 flow is > 500 Nm^3/h) has been implemented correctly in the</p> |

| | |
|-------------------|--|
| | spreadsheets and is traceable and transparent. Values over the monitoring period are correct. |
| Conclusion | <p>KFQ confirms that the monitoring 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</p> <ul style="list-style-type: none"> • The monitoring of the volume flow to the AOR has been carried out in accordance with the monitoring plan and any monitoring activities comply with it; and • The monitoring results of the volume flow to the AOR are consistently recorded as per the approved frequency; and • KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below; and • The QA/QC procedures are suitable and have been applied in accordance with the monitoring plan. |

| | |
|------------------------------|---|
| Data/Parameter | $h_{r,y,II}$ |
| Data Unit | h |
| Description | For tertiary N ₂ O abatement, Number of hours (<i>h</i>) in year <i>y</i> where the abatement system is by-passed, underperforming or failed of Hu-Chems II |
| Source of data used | Measuring device |
| Value(s) | 14 |
| Means of verification | <p>As per the applied methodology and the PDD, this parameter is determined based on measured data, applying following formula</p> $F_{N_2O, tail\ gas, h, II} > EF_{existing, y, II} \times P_{NA, h, II}$ <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. Values over the monitoring period are correct.</p> <p>The measured parameters based on which the determination of this parameter is done and that have been mentioned formula above, are verified in other tables of this section.</p> |
| Conclusion | 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. |

| | |
|------------------------------|---|
| Data/Parameter | $V_{t,db,II}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval <i>t</i> on a dry basis of Hu-Chems II |
| Source of data used | Measuring device |
| Value(s) | 45,595 (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports 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 03.0.0).</p> <p>Furthermore, procedures and records on calibration, maintenance as well as QA/QC and EN 14181 related activities have been reviewed, discussed in</p> |

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| | interviews and checked against the requirements out of the monitoring plan and the applied methodology. |
| Findings | <p>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found, that as described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual conditions ($P_{t,II}$ and $T_{t,II}$) are not necessary to be monitored.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. 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. 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

| | |
|------------------------------|--|
| Data/Parameter | $V_{i,t,db,II}$ |
| Data Unit | $m^3 \text{ gas } i / m^3 \text{ dry gas } \rightarrow (m^3 \text{ N}_2\text{O} / m^3 \text{ dry gas})$ |
| Description | Volumetric fraction of greenhouse gas i in a time interval t on a dry basis of plant Hu-Chems II |
| Source of data used | Measuring device Non-dispersive infrared (NDIR) photography analyser |
| Value(s) | $6.53 \cdot 10^{-5}$ (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports, 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 | Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring |

| | |
|-------------------|---|
| | <p>results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. The N₂O concentration is measured in ppmv and automatically converted to 'm³ N₂O/Nm³ dry gas' according to the applied methodology and tool. It was found, that at described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual conditions (P_{t,II} and T_{t,II}) are not necessary to be monitored.</p> <p>Through interview with staffs and sample review of trend curves for raw data and event logs, it was found that all operational events are identified and reported on the MR completely.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. The correction factor out of the calibration curve determined during the QAL 2 reference measurement (calibration) as well as results from QAL 3 (if applicable) has been correctly applied on an hourly basis in the emission reduction spreadsheet.</p> <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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

| | |
|------------------------------|--|
| Data/Parameter | C_{H2O,t,db,n,II} |
| Data Unit | mg H ₂ O/m ³ dry gas |
| Description | Moisture content of the gaseous stream at normal conditions, in time interval t of Hu-Chems II |
| Source of data used | Measurements according to the USEPA CF42 method 4-Gravimetric determination of water content (Measurement report) |
| Value(s) | 12,000 mg H ₂ O/m ³ dry gas (equivalent to 0.012 kg H ₂ O/m ³ dry gas) |
| 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 of QAL 2 report issued by the qualified, external entity AIRTEC. |
| Findings | <p>As per the PDD, the measurements of moisture content were conducted when the calibration of the flow meter for the gaseous stream (QAL2) were carried out. Repeated measurements were performed by AIRTEC coinciding with QAL2 reference measurements (QAL2 in September 2017). The repeated measurements were conducted in accordance with USEPA CF42 method 4.</p> <p>It was found that, according to the report, the moisture content of the gaseous stream is below 0.05 kg H₂O/m³ dry gas and thus significantly below the maximum threshold value of 0.05 kg H₂O/m³ dry gas. Therefore, as stated by the PPs in the MR and according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0.0), the gaseous stream is to be considered dry.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as</p> |

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| | per the approved frequency. KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan & relevant tool by the performing institute (AIRTEC). |
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| Data/Parameter | FC_{i,j,y,II} |
| Data Unit | t/yr |
| Description | Quantity of fuel type i combusted in process j during the year y of Hu-Chems II |
| Source of data used | Measuring device |
| Value(s) | 87,684 |
| 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 LPG invoice & propane balance book and DCS daily reports. Furthermore, the verification team checked the DCS daily reports 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>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR and all specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. The amount of LPG consumed in the system is measured in kg/hr by mass flow meter according to the monitoring plan. It was also found that the consistency and plausibility checks with purchased invoices and stock record were conducted for the value of FC_{i,j,y,II} as per QA/QC procedure in the monitoring plan.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | WC_{i,y,II} |
| Data Unit | tC/t |
| Description | Weighted average mass fraction of carbon in fuel type i in year y of Hu-Chems II |
| Source of data used | Certification of hydrocarbon supplier |
| Value(s) | 0.82 |
| Means of verification | The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by reviewing certificate and process for aggregation, recording and reporting process. Furthermore, the verification team |

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| | <p>checked the values reported in the emission reduction 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>Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The propane certificates containing propane composition are provided by the supplier on delivery and 21 times (for plant 2 & 3 together) in this monitoring period. It was also verified that the applied value is within the uncertainty range of IPCC default values as per the QA/QC procedures in accordance with the monitoring plan.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

All the other parameters (including their IDs, details available in the respective tables of the MR) are not applicable and not included here in this VR.

Plant specific parameters: Hu-Chems III

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| Data/Parameter | P_{production,y,III} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems III |
| Source of data used | Production reports |
| Value(s) | 25,203 |
| Means of verification | <p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. The verification team checked the DCS daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR. 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 flow and density are measured with a mass flow meter, temperature with a temperature measurement and concentration is automatically determined based on measured parameters. Values are sent to the DCS (control room), and the nitric acid production (as 100% HNO₃) is calculated based on mass flow and HNO₃ concentration. Final production values are exported in production reports through the DeltaV System. Data from the DeltaV daily reports are digitally transferred to spreadsheets where emission reduction calculations are performed. There were no errors found in the digital transfer of data from the DeltaV daily reports to the spreadsheets.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO</p> |

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| | 14001 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. |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it.</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, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p> |

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| Data/Parameter | $h_{y,III}$ |
| Data Unit | h |
| Description | Number of hours of operation in year y of Hu-Chems III |
| Source of data used | Measuring device |
| Value(s) | 2,131 |
| Means of verification | <p>As per the PDD, the flow of NH_3 to the ammonia oxidation reactor indicates the operational status. In case, the volume flow of NH_3 to the ammonia oxidation reactor lies above the threshold of 500 Nm^3/h during an hour, the reactor is considered in normal 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 respective monitoring plan.</p> <p>The KFQ verification team also checked, whether the monitoring activities in relation to the volume flow to the AOR 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 daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Location of instrument, coriolis flowmeter, for measuring the NH_3 flow to the AOR has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found that the determination of the parameter based on measured values (i.e. whether NH_3 flow is > 500 Nm^3/h) has been implemented correctly in the spreadsheets and is traceable and transparent. Values over the monitoring period are correct.</p> |
| Conclusion | <p>KFQ confirms that the monitoring 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</p> |

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| | <ul style="list-style-type: none"> The monitoring of the volume flow to the AOR has been carried out in accordance with the monitoring plan and any monitoring activities comply with it; and The monitoring results of the volume flow to the AOR are consistently recorded as per the approved frequency; and KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below; and The QA/QC procedures are suitable and have been applied in accordance with the monitoring plan. |
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| Data/Parameter | $h_{r,y,III}$ |
| Data Unit | h |
| Description | For tertiary N ₂ O abatement, Number of hours (<i>h</i>) in year <i>y</i> where the abatement system is by-passed, underperforming or failed of Hu-Chems III |
| Source of data used | Measuring device |
| Value(s) | 8 |
| Means of verification | <p>As per the applied methodology and the PDD, this parameter is determined based on measured data, applying following formula</p> $F_{N_2O, tail\ gas, h, III} > EF_{existing, y, III} \times P_{NA, h, III}$ <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. Values over the monitoring period are correct.</p> <p>The measured parameters based on which the determination of this parameter is done and that have been mentioned formula above, are verified in other tables of this section.</p> |
| Conclusion | 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. |

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| Data/Parameter | $V_{t,db,III}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval <i>t</i> on a dry basis of Hu-Chems III |
| Source of data used | Measuring device |
| Value(s) | 46,198 (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports 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 03.0.0).</p> <p>Furthermore, procedures and records on calibration, maintenance as well as QA/QC and EN 14181 related activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period. |

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| | <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found, that as described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual conditions ($P_{t,III}$ and $T_{t,III}$) are not necessary to be monitored.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. 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. 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | $V_{i,t,db,III}$ |
| Data Unit | $m^3 \text{ gas } i / m^3 \text{ dry gas } \rightarrow (m^3 \text{ N}_2\text{O} / m^3 \text{ dry gas})$ |
| Description | Volumetric fraction of greenhouse gas i in a time interval t on a dry basis of plant Hu-Chems III |
| Source of data used | Measuring device Non-dispersive infrared (NDIR) photography analyser |
| Value(s) | $4.15 \cdot 10^{-5}$ (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports, 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>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. The N_2O concentration is measured in ppmv and automatically converted to '$m^3 \text{ N}_2\text{O} / m^3 \text{ dry gas}$' according to the applied methodology and tool. It was found, that as described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual</p> |

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| | <p>conditions ($P_{t,III}$ and $T_{t,III}$) are not necessary to be monitored.</p> <p>Through interview with staffs and sample review of trend curves for raw data and event logs, it was found that all operational events are identified and reported on the MR completely.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. The correction factor out of the calibration curve determined during the QAL 2 reference measurement (calibration) as well as results from QAL 3 (if applicable) has been correctly applied on an hourly basis in the emission reduction spreadsheet.</p> <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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | $C_{H_2O,t,db,n,III}$ |
| Data Unit | mg H ₂ O/m ³ dry gas |
| Description | Moisture content of the gaseous stream at normal conditions, in time interval t of Hu-Chems III |
| Source of data used | Measurements according to the USEPA CF42 method 4-Gravimetric determination of water content (Measurement report) |
| Value(s) | 12,000 mg H ₂ O/m ³ dry gas (equivalent to 0.012 kg H ₂ O/m ³ dry gas) |
| 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 of QAL 2 and AST reports issued by the qualified, external entity AIRTEC. |
| Findings | <p>As per the PDD, the measurements of moisture content were conducted when the calibration of the flow meter for the gaseous stream (QAL2) were carried out. Repeated measurements were performed by AIRTEC coinciding with QAL2 reference measurements and annual surveillance tests (QAL2 in September 2016 and AST in August 2017). The repeated measurements were conducted in accordance with USEPA CF42 method 4.</p> <p>It was found that, according to the report, the moisture content of the gaseous stream is below 0.05 kg H₂O/m³ dry gas and thus significantly below the maximum threshold value of 0.05 kg H₂O/m³ dry gas. Therefore, as stated by the PPs in the MR and according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0.0), the gaseous stream is to be considered dry.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan & relevant tool by the performing institute (AIRTEC).</p> |

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| Data/Parameter | $FC_{i,j,v,III}$ |
| Data Unit | t/yr |

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| Description | Quantity of fuel type i combusted in process j during the year y of Hu-Chems III |
| Source of data used | Measuring device |
| Value(s) | 93,034 |
| 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 LPG invoice & propane balance book and DCS daily reports. Furthermore, the verification team checked the DCS daily reports 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>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR and all specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period. The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. The amount of LPG consumed in the system is measured in kg/hr by mass flow meter according to the monitoring plan. It was also found that the consistency and plausibility checks with purchased invoices and stock record were conducted for the value of $FC_{i,j,y,III}$ as per QA/QC procedure in the monitoring plan.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | $W_{C,i,y,III}$ |
| Data Unit | tC/t |
| Description | Weighted average mass fraction of carbon in fuel type i in year y of Hu-Chems III |
| Source of data used | Certification of hydrocarbon supplier |
| Value(s) | 0.82 |
| Means of verification | <p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by reviewing certificate and process for aggregation, recording and reporting process. Furthermore, the verification team checked the values reported in the emission reduction 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 | Monitoring results are fully available at the required intervals for the whole monitoring period. |

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| | The propane certificates containing propane composition are provided by the supplier on delivery and 21 times (for plant 2&3 together) in this monitoring period. It was also verified that the applied value is within the uncertainty range of IPCC default values as per the QA/QC procedures in accordance with the monitoring plan. |
| Conclusion | 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. KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below. KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology. |

All the other parameters (including their IDs, details available in the respective tables of the MR) are not applicable and not included here in this VR.

Plant specific parameters: Hu-Chems IV

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| Data/Parameter | P_{production,y,IV} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems IV |
| Source of data used | Production reports |
| Value(s) | 89,035 |
| Means of verification | <p>The KFQ verification team checked, whether the monitoring activities in relation to this parameter comply with the monitoring plan by physically inspecting the applied measuring device & related equipment for generation, aggregation, recording and reporting. The verification team checked the DCS daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Locations of instruments have been verified by physical inspection and are in accordance with the description in the MR. 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 flow and density are measured with a mass flow meter, temperature with a temperature measurement and concentration is automatically determined based on measured parameters. Values are sent to the DCS (control room), and the nitric acid production (as 100% HNO₃) is calculated based on mass flow and HNO₃ concentration. Final production values are exported in production reports through the DeltaV System. Data from the DeltaV daily reports are digitally transferred to spreadsheets where emission reduction calculations are performed. There were no errors found in the digital transfer of data from the DeltaV daily reports to the spreadsheets.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 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.</p> |
| Conclusion | 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. |

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| | <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan.</p> |
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| Data/Parameter | $h_{y,IV}$ |
| Data Unit | h |
| Description | Number of hours of operation in year y of Hu-Chems IV |
| Source of data used | Measuring device |
| Value(s) | 2,184 |
| Means of verification | <p>As per the PDD, the flow of NH_3 to the ammonia oxidation reactor indicates the operational status. In case, the volume flow of NH_3 to the ammonia oxidation reactor lies above the threshold of 500 Nm^3/h during an hour, the reactor is considered in normal 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 respective monitoring plan.</p> <p>The KFQ verification team also checked, whether the monitoring activities in relation to the volume flow to the AOR 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 daily reports and compared the values reported in the excel spreadsheets. All results have been verified against the requirements out of the monitoring plan and the applied methodology.</p> <p>Furthermore, procedures and records on calibration, maintenance and QA/QC activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Location of instrument, coriolis flowmeter, for measuring the NH_3 flow to the AOR has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found that the determination of the parameter based on measured values (i.e. whether NH_3 flow is > 500 Nm^3/h) has been implemented correctly in the spreadsheets and is traceable and transparent. Values over the monitoring period are correct.</p> |
| Conclusion | <p>KFQ confirms that the monitoring 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</p> <ul style="list-style-type: none"> • The monitoring of the volume flow to the AOR has been carried out in accordance with the monitoring plan and any monitoring activities comply with it; and • The monitoring results of the volume flow to the AOR are consistently recorded as per the approved frequency; and • KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below; and • The QA/QC procedures are suitable and have been applied in accordance |

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| | with the monitoring plan. |
| Data/Parameter | $h_{r,y,IV}$ |
| Data Unit | h |
| Description | For tertiary N ₂ O abatement, Number of hours (<i>h</i>) in year <i>y</i> where the abatement system is by-passed, underperforming or failed of Hu-Chems IV |
| Source of data used | Measuring device |
| Value(s) | 0 |
| Means of verification | <p>As per the applied methodology and the PDD, this parameter is determined based on measured data, applying following formula</p> $F_{N_2O, tail\ gas, h, IV} > EF_{existing, y, IV} \times P_{NA, h, IV}$ <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. Values over the monitoring period are correct.</p> <p>The measured parameters based on which the determination of this parameter is done and that have been mentioned formula above, are verified in other tables of this section.</p> |
| Conclusion | 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. |

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| Data/Parameter | $V_{t,db,IV}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval <i>t</i> on a dry basis of Hu-Chems IV |
| Source of data used | Measuring device |
| Value(s) | 174,634 (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports 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 03.0.0).</p> <p>Furthermore, procedures and records on calibration, maintenance as well as QA/QC and EN 14181 related activities have been reviewed, discussed in interviews and checked against the requirements out of the monitoring plan and the applied methodology.</p> |
| Findings | <p>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. DCS System generates aggregated daily reports based on stored raw data. Data from daily reports are digitally transferred to spreadsheets, where emission reduction calculations are performed. There were no errors in the digital transfer of data from the DCS daily reports to the spreadsheets.</p> <p>It was found, that as described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual conditions ($P_{t,IV}$ and $T_{t,IV}$) are not necessary to be</p> |

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| | <p>monitored.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO 14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. 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. 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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | $V_{i,t,db,IV}$ |
| Data Unit | m ³ gas i/m ³ dry gas → (m ³ N ₂ O/m ³ dry gas) |
| Description | Volumetric fraction of greenhouse gas i in a time interval t on a dry basis of plant Hu-Chems IV |
| Source of data used | <p>Measuring device</p> <p>Non-dispersive infrared (NDIR) photography analyser</p> |
| Value(s) | $4.06 \cdot 10^{-5}$ (average value over 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 DCS daily reports. Furthermore, the verification team checked the DCS daily reports, 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>Location of instrument has been verified by physical inspection and is in accordance with the description in the MR. All specifications in relation of this parameter are fulfilled and suitable instrument and range are used. Monitoring results are fully available at the required intervals for the whole monitoring period.</p> <p>The instrument continuously provides an analogue signal to an I/O card. Data are made available in the network system as digital values and are stored by a server. The N₂O concentration is measured in ppmv and automatically converted to 'm³ N₂O/Nm³ dry gas' according to the applied methodology and tool. It was found, that as described in the monitoring plan, that this parameter is automatically expressed at normal conditions and thus, clearly according to the applied methodology, actual conditions ($P_{t,IV}$ and $T_{t,IV}$) are not necessary to be monitored.</p> <p>Through interview with staffs and sample review of trend curves for raw data and event logs, it was found that all operational events are identified and reported on the MR completely.</p> <p>The calibration and maintenance routines for the parameter are the responsibility of Hu-Chems. The QA/QC and related procedures are covered by the ISO 9001 / ISO</p> |

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| | <p>14001 Quality Management Procedures of the nitric acid plant. In addition, QA is covered by EN 14181, especially QAL 2 reference measurements (calibration). Valid calibration covering the whole monitoring period is available for the used equipment. The correction factor out of the calibration curve determined during the QAL 2 reference measurement (calibration) as well as results from QAL 3 (if applicable) has been correctly applied on an hourly basis in the emission reduction spreadsheet.</p> <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.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that the equipment used for monitoring of this parameter is calibrated in accordance with the monitoring plan, the applied methodology as well as methodological tools and the relevant guidance provided by the CDM Executive Board. Details on calibration are given in section E.7 below.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan and the applied methodology.</p> |

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| Data/Parameter | C_{H2O,t,db,n,IV} |
| Data Unit | mg H ₂ O/m ³ dry gas |
| Description | Moisture content of the gaseous stream at normal conditions, in time interval t of Hu-Chems IV |
| Source of data used | Measurements according to the USEPA CF42 method 4-Gravimetric determination of water content (Measurement report) |
| Value(s) | 8,000 (equivalent to 0.008 kg H ₂ O/m ³ dry gas) |
| 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 of QAL 2 and AST reports issued by the qualified, external entity AIRTEC. |
| Findings | <p>As per the PDD, the measurements of moisture content were conducted when the calibration of the flow meter for the gaseous stream (QAL2) were carried out. Repeated measurements were performed by AIRTEC coinciding with QAL2 reference measurements (QAL2 in August 2017). The repeated measurements were conducted in accordance with USEPA CF42 method 4.</p> <p>It was found that, according to the report, the moisture content of the gaseous stream is below 0.05 kg H₂O/m³ dry gas and thus significantly below the maximum threshold value of 0.05 kg H₂O/m³ dry gas. Therefore, as stated by the PPs in the MR and according to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0.0), the gaseous stream is to be considered dry.</p> |
| Conclusion | <p>KFQ confirms that the monitoring of this parameter has been carried out in accordance with the monitoring plan and any monitoring activities comply with it. KFQ confirms that monitoring results of this parameter are consistently recorded as per the approved frequency.</p> <p>KFQ confirms that QA/QC procedures are suitable and have been applied in accordance with the monitoring plan & relevant tool by the performing institute (AIRTEC).</p> |

All the other parameters (including their IDs, details available in the respective tables of the MR) are not applicable and not included here in this VR.

Social Fund

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| Means of verification | The KFQ verification team reviewed the protocol from the social fund committee as well as a balance sheet and transaction records for the contribution of the CDM Project Activity to the social fund for all years between 2007 and 2017. |
| Findings | The KFQ verification team found that the figures stated in the MR with regard to the contributions of the CDM project activity to the social fund were in line with the |

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| | actual situation. The information for 2018 will be aggregated in the end of this year and thus reported in a later monitoring period consistent with PP's accounting year. |
| Conclusion | KFQ confirms that the PPs have effectively invested a share of the income from the sale of CERs in the Social Fund to support local projects in the area of the project activity (Yeosu) and that the amounts are correctly stated in the MR. |

E.6.3. Implementation of sampling plan

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

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

General statement

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| Means of verification | The means of verification in relation to the specific instruments are stated in detail in the tables further below. |
| Findings | The findings in relation to the specific instruments are stated in detail in the tables further below. |
| Conclusion | KFQ confirms that the calibration of the measuring equipment has been conducted as per the applied methodology and the monitoring plan. KFQ confirms, that there has not been any calibration delay for any instrument affecting the verification period and thus, there is no error to be applied on any monitored parameters. |

The table of the CDM-VCR-FORM has been used for the assessment, following rows as needed have been added: Data/Parameter, Data Unit, Description, Serial Number, Type, Accuracy level, Calibration entity, Calibration frequency, Previous calibration (when applicable), Latest calibration, Applied period of max. permissible error (when applicable). Some parameters involve several instruments, table rows have been added as needed accordingly.

Plant specific parameters: Hu-Chems II

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| Data/Parameter | P_{production,y,II} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems II |
| TAG Number / Serial Number | TAG Number: 322-FT-2-512 / Serial number: 14325173 |
| Type | Coriolis Flowmeter |
| Accuracy level | ± 0.35% |
| Calibration entity | FMTech (as per KOLAS) |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 12/08/2016 (Validity: 11/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. It was found, that the instrument had a valid calibration covering the whole verification period and |

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| | was working within the specified error ranges as per available, suitable certificates. |
| 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. |
| TAG Number / Serial Number | TAG Number: 322-TI-2-127 / Serial number: 51305907-175 |
| Type | Temperature Converter |
| Accuracy level | ± 0.15% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 23/08/2017 (Validity: 22/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated and as per the defined requirements No delay of calibration has been observed. It was found, that the instrument had a valid calibration covering whole verification period and was working within the specified error ranges as per available, suitable certificates. |
| 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. |

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| Data/Parameter | $h_{y,II}$ |
| Data Unit | h (determined based on ammonia flow Nm ³ /h) |
| Description | Number of hours of operation in year y of Hu-Chems II |
| TAG Number / Serial Number | TAG Number: 322-FT-2-503 / Serial number: 2052133 |
| Type | Differential pressure transmitter |
| Accuracy level | ± 0.5% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 24/08/2017 (Validity: 23/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |

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| 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. |
| TAG Number / Serial Number | TAG Number: 322-TT-2-103 / Serial number:1809806 |
| Type | Temperature transmitter |
| Accuracy level | ± 0.15% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 24/08/2017 (Validity: 23/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |
| TAG Number / Serial Number | TAG Number: 322-PT-2-303 / Serial number: 2052135 |
| Type | Pressure transmitter |
| Accuracy level | ± 0.1% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 24/08/2017 (Validity: 23/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |

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| Data/Parameter | $V_{t,db,II}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval t on a dry basis of Hu-Chems II |
| TAG Number / Serial Number | TAG Number: 322-FT-2-522 / Serial number: 1240833 |
| Type | Annubar |
| Accuracy level | ± 2% of span |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | QAL2: 27/09/2017 to 29/09/2017 (validity: 26/09/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been installed and has a valid QAL 1 certification. It was found that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity AIRTEC during 27/09/2017 to 29/09/2017.</p> <p>It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period of Hu-Chems II, based on physical inspection and installation & operation records. This, and the fact, that the QAL2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period. Which enables KFQ to confirm that the QAL2 measurement done in September 2017 & applied for the whole monitoring period of Hu-Chems II is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times.</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 and the applied methodology. |

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| Data/Parameter | $V_{i,t,db,II}$ |
| 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 of plant Hu-Chems II |
| TAG Number / Serial Number | TAG Number: 322-AT-2-0127 / Serial number: 990861497812 |
| Type | NDIR Analyser |
| Accuracy level | ± 1% (zero/span) |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |

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| Latest calibration | QAL2: 27/09/2017 to 29/09/2017 (validity: 26/09/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated and as per the defined requirements. It was found that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>In accordance with EN14181, NDIR analyser (Emerson NGA 2000) has valid QAL 1 certification and QAL 2 reference measurements were performed as per required standards by the qualified entity AIRTEC during 27/09/2017 to 29/09/2017. It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period of Hu-Chems II, based on physical inspection and installation & operation records. This, and the fact, that the QAL 2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period. Which enables KFQ to confirm that the measurement done in September 2017 & applied for the whole monitoring period of Hu-Chems II is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times.</p> <p>Furthermore, the analyser is self-calibrated (zero, span) using a set of certified calibration gases in accordance with EN 14181. The calibration gases applied were marked to be stable in the verifying period and cover the range of measurement. Detailed supplier certificates including information on concentration, accuracy and stability are available.</p> <p>Control check for zero/span test result was conducted as shown in SHEWHART CONTROL CHART – #2 Nitric Acid Plant.</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 and the applied methodology. |

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| Data/Parameter | FC_{i,j,y,II} |
| Data Unit | t/yr |
| Description | Quantity of fuel type i combusted in process j during the year y of Hu-Chems II |
| TAG Number / Serial Number | TAG Number: 322-FT-2-5121 / Serial number: 14126211 |
| Type | Coriolis Flowmeter |
| Accuracy level | ± 0.35% |
| Calibration entity | FM Tech (as per KOLAS) |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 18/08/2017 (Validity: 17/08/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 |

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| | methodology and the monitoring plan as well as instrument specifications including manufacturer recommended frequencies. |
| Findings | <p>It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed.</p> <p>It was found, that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> |
| Conclusion | 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. |

Plant specific parameters: Hu-Chems III

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| Data/Parameter | P_{production,y,III} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems III |
| TAG Number / Serial Number | TAG Number: 323-FT-3-512 / Serial number: 14266864 |
| Type | Coriolis Flowmeter |
| Accuracy level | ± 0.35% |
| Calibration entity | FM Tech (as per KOLAS) |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 18/08/2017 (Validity: 17/08/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |
| TAG Number / Serial Number | TAG Number: 323-TI-3-127 / Serial number: 51309204-125 |
| Type | Temperature Converter |
| Accuracy level | ± 0.15% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration | 17/08/2016 (Validity: 16/08/2020) |
| Latest calibration | 26/07/2018 (Validity: 25/07/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | The KFQ verification team has visually checked the physical existence of the instrument. The KFQ verification team has checked the calibration records & |

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| | 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 | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |

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| Data/Parameter | $h_{y,III}$ |
| Data Unit | h (determined based on ammonia flow Nm ³ /h) |
| Description | Number of hours of operation in year y of Hu-Chems III |
| TAG Number / Serial Number | TAG Number: 323-FT-3-503 / Serial number: 2052134 |
| Type | Differential pressure transmitter |
| Accuracy level | ± 0.5% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | 17/08/2016 (Validity: 16/08/2020) |
| Latest calibration | 25/07/2018 (Validity: 24/07/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |
| TAG Number / Serial Number | TAG Number: 323-TT-3-103 / Serial number: 1809794 |
| Type | Temperature transmitter |
| Accuracy level | ± 0.15% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | 17/08/2016 (Validity: 16/08/2020) |
| Latest calibration | 26/07/2018 (Validity: 25/07/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 |

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| | methodology and the monitoring plan as well as instrument specifications including manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |
| TAG Number / Serial Number | TAG Number: 323-PT-3-303 / Serial number: 2052136 |
| Type | Pressure transmitter |
| Accuracy level | ± 0.1% of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration (if applicable) | 17/08/2016 (Validity: 16/08/2020) |
| Latest calibration | 27/07/2018 (Validity: 26/07/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |

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| Data/Parameter | $V_{t,db,III}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval t on a dry basis of Hu-Chems III |
| TAG Number / Serial Number | TAG Number: 323-FT-3-522 / Serial number: 1240832 |
| Type | Annubar |
| Accuracy level | ± 2% of span |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | QAL2: 06/09/2016 to 08/09/2016 (validity: 05/09/2021) AST: 31/08/2017 to 01/09/2017 |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 |

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| | 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 MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been installed and has a valid QAL 1 certification.</p> <p>It was found that the instrument had a valid calibration covering the whole verification period and was working within the specified error ranges as per available, suitable certificates.</p> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity AIRTEC during 06/09/2016 to 08/09/2016 and latest AST was performed from 31/08/2017 to 01/09/2017.</p> <p>It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period of Hu-Chems III, based on physical inspection and installation & operation records. This, and the fact, that the QAL 2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period.</p> <p>Which enables KFQ to confirm that the measurement done in August/September 2016/2017 & applied for the whole monitoring period of Hu-Chems III is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times.</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 and the applied methodology. |

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| Data/Parameter | $V_{i,t,db,III}$ |
| 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 of plant Hu-Chems III |
| TAG Number / Serial Number | TAG Number: 323-AT-3-0127 / Serial number: 990861497815 |
| Type | NDIR Analyser |
| Accuracy level | ± 1% (zero/span) |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | QAL2: 06/09/2016 to 08/09/2016 (validity: 05/09/2021) AST: 31/08/2017 to 01/09/2017 |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 MR, physically exists and could be identified by the TAG Number and 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> <p>In accordance with EN14181, NDIR analyser (Emerson NGA 2000) has valid QAL 1 certification and QAL 2 reference measurements were performed as per required standards by the qualified entity AIRTEC during 06/09/2016 to 08/09/2016. An AST test was performed from 31/08/2017 to 01/09/2017.</p> |

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| | <p>It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period of Hu-Chems III, based on physical inspection and installation & operation records. This, and the fact, that the QAL 2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period.</p> <p>Which enables KFQ to confirm that the measurement done in August/September 2016/2017 & applied for the whole monitoring period of Hu-Chems III is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times.</p> <p>Furthermore, the analyser is self-calibrated (zero, span) using a set of certified calibration gases in accordance with EN 14181.</p> <p>The calibration gases applied were marked to be stable in the verifying period and cover the range of measurement. Detailed supplier certificates including information on concentration, accuracy and stability are available.</p> <p>Control check for zero/span test result was conducted as shown in SHEWHART CONTROL CHART – #3 Nitric Acid Plant.</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 and the applied methodology. |

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| Data/Parameter | FC_{i,j,y,III} |
| Data Unit | t/yr |
| Description | Quantity of fuel type i combusted in process j during the year y of Hu-Chems III |
| TAG Number / Serial Number | TAG Number: 323-FT-3-5121 / Serial number: 14125454 |
| Type | Coriolis Flowmeter |
| Accuracy level | ± 0.35% |
| Calibration entity | FM Tech (as per KOLAS) |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 12/08/2016 (Validity: 11/08/2021) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. It was found, that the instrument has a valid calibration covering the monitoring period and was working within the specified error ranges as per available, suitable certificates. |
| 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. |

Plant specific parameters: Hu-Chems IV

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| Data/Parameter | P_{production,y,IV} |
| Data Unit | tHNO ₃ |
| Description | Nitric acid produced in year y of Hu-Chems IV |

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| TAG Number / Serial Number | TAG Number: 324-FT-4-609 / Serial number: 14735413 |
| Type | Coriolis Flowmeter |
| Accuracy level | $\pm 0.35\%$ |
| Calibration entity | Micro Motion, Inc. |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 18/10/2017 (Validity: 17/10/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |
| TAG Number / Serial Number | TAG Number: 324-TT-4-237 / Serial number: 966595 |
| Type | Temperature Transmitter |
| Accuracy level | $\pm 0.15\%$ of span |
| Calibration entity | EMERSON |
| Calibration frequency | 48 months |
| Previous calibration | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 17/04/2018 (Validity: 16/04/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |

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| Data/Parameter | $h_{y,IV}$ |
| Data Unit | h (determined based on ammonia flow Nm^3/h) |
| Description | Number of hours of operation in year y of Hu-Chems IV |
| TAG Number / Serial Number | TAG Number: 324-FT-4-5020 / Serial number: 14137655 |
| Type | Coriolis Flowmeter |

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| Accuracy level | ± 0.35% |
| Calibration entity | FM Tech (as per KOLAS) |
| Calibration frequency | 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | 27/05/2014 (Validity: 26/05/2019) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 manufacturer recommended frequencies. |
| Findings | It was found that the instrument, as stated in the MR, physically exists and could be identified by the TAG Number and the serial number. It was found that the instrument has been calibrated regularly and as per the defined requirements. No delay of calibration has been observed. 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. |
| 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. |

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| Data/Parameter | $V_{t,db,IV}$ |
| Data Unit | m ³ dry gas/h |
| Description | Volumetric flow of the gaseous stream in time interval t on a dry basis of Hu-Chems IV |
| TAG Number / Serial Number | TAG Number: 324-FT-4-522 / Serial number: 1240834 |
| Type | Annubar |
| Accuracy level | ± 2% of span |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | QAL 2: 28/08/2017 to 30/08/2017 (validity: 27/08/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 MR, physically exists and could be identified by the TAG Number and 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> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity AIRTEC during 28/08/2017 to 30/08/2017. It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period, based on physical inspection and installation & operation records. This, and the fact, that the QAL 2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period enables KFQ to confirm that</p> |

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| | the measurements done in August 2017 & applied for the whole monitoring period is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times. Valid QAL 1 certification was found to be in place and available. |
| 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. |

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| Data/Parameter | $V_{i,t,db,IV}$ |
| 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 of plant Hu-Chems IV |
| TAG Number / Serial Number | TAG Number: 324-AT-4-0107 / Serial number: 990861497818 |
| Type | NDIR Analyser |
| Accuracy level | ± 1% (zero/span) |
| Calibration entity | AIRTEC |
| Calibration frequency | (EN 14181/QAL 2) 60 months |
| Previous calibration (if applicable) | N/A (latest calibration is valid for whole monitoring period) |
| Latest calibration | QAL 2: 28/08/2017 to 30/08/2017 (validity: 27/08/2022) |
| The applied period of max. permissible error (when applicable) | N/A (no calibration delay) |
| Means of verification | 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 MR, physically exists and could be identified by the TAG Number and 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> <p>In accordance with EN14181, QAL 2 reference measurement as per required standards was performed by the qualified entity AIRTEC during 28/08/2017 to 30/08/2017. It was found that the technical features of the instrument in terms of the CDM Project / Monitoring were exactly the same since the start of the monitoring period, based on physical inspection and installation & operation records. This, and the fact, that the QAL 2 calibration factors (the calibration curve) were clearly & traceably applied to the monitored values in the MS Excel sheets for all values of the whole monitoring period enables KFQ to confirm that the measurements done in August 2017 & applied for the whole monitoring period is representative for the whole monitoring period due to the same characteristics and reliability of the instrument used at all times. Valid QAL 1 certification was found to be in place and available.</p> <p>Furthermore, the analyser is self-calibrated (zero, span) using a set of certified calibration gases in accordance with EN 14181. The calibration gases applied were marked to be stable in the verifying period and cover the range of measurement. Detailed supplier certificates including information on concentration, accuracy and stability are available.</p> <p>Control check for zero/span test result was conducted as shown in SHEWHART CONTROL CHART – #4 Nitric Acid Plant.</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 and 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**

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| Means of verification | <p>KFQ has reviewed all 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) as well as the PDD (Version 4.2 dated on 18/12/2017) as well as relevant tools applied.</p> <p>KFQ has also assessed the completeness, quality and appropriateness of the data, parameters and calculations.</p> <p>Furthermore, KFQ has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PPs have been justified and correctly applied, in line with the requirements.</p> <p>KFQ has further crosschecked – as applicable - any information with other sources available, such as but not limited to production log sheets, meters available in the operators control room or on-site, etc.</p> |
| Findings | <p>The baseline GHG emissions have been found to be 319,507 tCO₂e for the verification period. The figure is based on the operation of the EnviNOx® systems in plants Hu-Chems II, III and IV.</p> <p>It was found that a complete set of data covering the monitoring period has been provided by the PPs. Activity levels and non-activity parameters have been monitored in accordance with the monitoring plan, as applicable.</p> <p>The calculation was found to be correct as well as carried out in accordance with the formulae and methods described in the monitoring methodology ACM0019 (version 02) and the registered PDD (Version 4.2 dated 18/12/2017).</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 DeltaV DCS provided by Emerson. 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 DeltaV DCS. All actions performed at the computer station are logged and the log file is available for KFQ. There were no errors in the digital transfer of data from DeltaV 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 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 PPs have followed appropriate methods and formulae for calculating baseline GHG emissions have been followed.</p> |

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

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| Means of verification | <p>KFQ has reviewed all data, parameters and calculations with respect to calculation of the project GHG emissions and checked them against the requirements out of the applied methodology (ACM0019 – Version 02) and the PDD (Version 4.2 dated 18/12/2017), as well as relevant tools applied.</p> <p>KFQ has also assessed the completeness, quality and appropriateness of the data, parameters and calculations.</p> <p>Furthermore, KFQ has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PPs have been justified and correctly applied, in line with the requirements.</p> <p>KFQ 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 14,428 tCO₂e for the verification period. The figure is based on the operation of the EnviNOx® systems in plants Hu-Chems II, III and IV.</p> <p>It was found that a complete set of data covering the monitoring period has been provided by the PPs. Activity levels and non-activity parameters have been monitored in accordance with the monitoring plan, as applicable.</p> <p>The calculation was found to be correct as well as carried out in accordance with the formulae and methods described in the monitoring methodology, ACM0019 (Version 02) and the PDD (Version 4.2 dated 18/12/2017), as well as relevant tools applied.</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 DeltaV DCS provided by Emerson. 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 DeltaV DCS. All actions performed at the computer station are logged and the log file is available for KFQ. There were no errors in the digital transfer of data from DeltaV 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</p> |

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| | <p>performed as described.</p> <p>KFQ confirms that the PPs 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> |
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E.8.3. Calculation of leakage GHG emissions

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| Means of verification | KFQ has checked, whether leakage emissions (if any) were determined by the PPs in accordance with the applied methodology and the PDD. |
| Findings | KFQ has found that the approach applied by the PPs that leakage emissions need not to be considered (i.e. being considered zero, consequently) is in accordance to the applied methodology ACM0019 (Version 2). |
| Conclusion | KFQ confirms that the PPs 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

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|------------------------------|--|
| Means of verification | <p>KFQ has reviewed all 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) and the PDD (Version 4.2 dated 18/12/2017), as well as relevant tools applied.</p> <p>KFQ has also assessed the completeness, quality and appropriateness of the data, parameters and calculations.</p> <p>Furthermore, KFQ has assessed, whether any assumptions, emission factors, default values, GWPs or other reference values – as applicable – used by the PPs have been justified and correctly applied, in line with the requirements.</p> <p>KFQ 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 305,079 tCO₂e for the verification period. The figure is based on the operation of the EnviNOx® system in plants Hu-Chems II, III and IV.</p> <p>It was found that the first day on which CERs are being claimed in this verification period has been correctly specified by the PPs, being 07/05/2018.</p> <p>It was found that a complete set of data covering the monitoring period has been provided by the PPs. Activity levels and non-activity parameters have been monitored in accordance with the monitoring plan, as applicable.</p> <p>The calculation was found to be correct as well as carried out in accordance with the formulae and methods described in the monitoring methodology ACM0019 (version 02) and the PDD (Version 4.2 dated 18/12/2017), as well as relevant tools applied.</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 DeltaV DCS provided by Emerson. 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 DeltaV DCS. All actions performed at the computer station are logged and the log file is available for KFQ. There were no errors in the digital transfer of data from DeltaV 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</p> |

| | |
|-------------------|---|
| | <p>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. Findings 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> |
| Conclusion | <p>KFQ confirms that all required data for the calculation of GHG emission reductions were available for the whole verification period and no data were missing due to any non-monitoring of activity levels or non-activity parameters.</p> <p>KFQ confirms that suitable cross-checking of data was possible and has been performed as described.</p> <p>KFQ confirms that the PPs 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 07/05/2018, i.e. later than 31/12/2012. No pro-rata approach is applicable.</p> <p>KFQ finally confirms that the amount of emission reductions claimed by the PPs for the verification period from 07/05/2018 to 05/08/2018, amounting to 305,079 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 | <p>KFQ compared the ex-ante estimation of emission reductions in the registered PDD with the emission reductions reported by the PPs in the MR. Furthermore, the value, especially the production of nitric acid applied in the estimation of emission reductions in the registered PDD were reviewed.</p> |
| Findings | <p>KFQ found that the emission reductions for this monitoring period, from 07/05/2018 to 05/08/2018 (91 days) in the PDD were estimated as 307,101 tCO₂e (value rounded down). The actual emission reductions reported by the PPs during the same period were 305,079 tCO₂e and is thus lower than the value estimated in the PDD.</p> <p>The ex-ante estimation in the PDD was 267,008 tCO₂e, 291,595 tCO₂e and 673,174 tCO₂e which corresponds to 66,569 tCO₂e, 72,699 tCO₂e and 167,832 tCO₂e for plant Hu-Chems II, III and IV respectively during the 91 days of the verification period. The emission reductions reported by the PPs during the same period for the plants Hu-Chems II, III and IV were 80,918 tCO₂e, 81,961 tCO₂e and 142,200 tCO₂e respectively. Thus the emission reductions in plant Hu-Chems II and III are higher than the ex-ante PDD estimation respectively which are mainly due to shorter maintenance & shutdown periods in this monitoring period.</p> <p>It was found that the PPs have correctly described the situation in the MR as well.</p> |
| Conclusion | <p>KFQ confirms that the overall emission reductions of the project activity were below the ex-ante estimation in the PDD.</p> <p>KFQ confirms that the emission reductions claimed by the PPs are reasonable.</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. As there is actual increase of actual GHG emission reductions in plant Hu-Chems II and III (refer to E.8.5), the cause of the increase were investigated in the context of the amount of nitric acid and operating days applied in the registered PDD with each estimated ER calculation sheet. |
| Findings | As discussed in E.8.5 above, the emission reductions reported by the PPs during the monitoring period were 305,079 tCO ₂ e and is thus lower than the value estimated in the PDD. However the emission reductions in each plant, Hu-Chems II and III are higher than estimated in the PDD for that plant due to shorter NA plant shutdown and less maintenance periods as expected, which was confirmed through comparing with those in the registered PDD with estimated ER calculation sheets validated and interview with staff in plant. |
| Conclusion | KFQ confirms that the cause of increase in the actual GHG emissions reductions of the nitric acid plant Hu-Chems II and III were well justified during the verification period. KFQ confirms that the emission reductions claimed by the PPs are reasonable. |

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 305,079 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 PPs 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 complete conducted in accordance with the registered PDD, the applied methodology. |
| Conclusion | KFQ arrived at the conclusion that the GHG emission reductions reported in the MR and claimed by the PPs are correctly determined with 305,079 tCO ₂ e for the covered verification period between 07/05/2018 to 05/08/2018. This implies, that 100% of the reported GHG emission reduction in this verification period has been achieved in a period after the end of 31/12/2012, i.e. the first commitment period is untouched by this verification period. |

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

| | |
|------------------------------|--|
| Means of verification | The PPs have 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 underwent a technical review before being submitted to the PPs for requesting issuance CERs. The technical review was performed by technical review

team composed of a person qualified for this project activity in accordance with KFQ's qualification scheme for CDM project validation and verification.

SECTION G. Verification opinion

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Through the verification of the MR of the CDM project activity "Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp." in accordance with VVS (version 01.0), KFQ could confirm that:

- The project activity has been implemented and operated as per the registered PDD (Version 4.2, dated 18/12/2017),
- The installed equipment being essential for generating emission reduction runs reliably and is calibrated appropriately,
- The monitoring plan is as per the applied methodology,
- The monitoring plan in MR is as per the monitoring plan in the registered PDD,
- 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 (v.01.1) 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:

| | |
|---|--|
| Title of project activity | Catalytic N ₂ O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp. |
| UNFCCC Reference Number | 0765 |
| Date of registration | 22/01/2007 |
| Renewal date | 05/02/2014 |
| Registered PDD (2 nd crediting period) | 18/12/2017 (Version 4.2) |
| Methodology applied | ACM0019 (Version 02) |
| Final version of MR | 01.1 (dated 14/09/2018) |
| Crediting period | 22/01/2014 to 21/01/2021 |
| Monitoring period | 07/05/2018 to 05/08/2018 |
| Total GHG emission Reductions Verified | Baseline emissions: 319,507 tonnes CO _{2e} Project emissions: 14,428 tonnes CO _{2e} Leakage: 0 tonnes CO _{2e} Emission reductions: <u>305,079 tonnes CO_{2e}</u> |

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

SECTION H. Certification statement

Korean Foundation for Quality has performed the periodic verification of the emission reductions that have been reported for the CDM project activity "Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp." (UNFCCC Registration Ref. No. 0765) for the period 07/05/2018 to 05/08/2018.

The PPs are responsible for the collection of data in accordance with the monitoring plan and the reporting of GHG emissions reductions from the project.

It is KFQ's responsibility to express an independent verification statement on the reported GHG emission reductions from the project.

KFQ conducted the verification on the basis of the monitoring methodology ACM0019 (version 02), the registered PDD of 18/12/2017 (version 4.2), the validation report (dated 07/11/2013) and the MR (version 01.1) dated 14/09/2018. The verification included i) checking whether the provisions of the monitoring methodology and the monitoring plan were consistently and appropriately applied and ii) the collection of evidence supporting the reported data.

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 destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp." (UNFCCC Registration Ref. No. 0765) for the period from 07/05/2018 to 05/08/2018 are fairly stated in the MR (v.01.1).

The data generation, aggregation, recording, calculation and reporting of GHG emission reductions were conducted correctly on the basis of the approved baseline and monitoring methodology ACM0019 (version 02) and the monitoring plan contained in the registered PDD.

Hence, KFQ is able to certify that the emission reductions from the "Catalytic N₂O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp." during the period from 07/05/2018 to 05/08/2018 are 305,079 tCO₂e.

Signed on behalf of the Korean Foundation for Quality

Signature : 

Name : Soon Hong YEOM, Managing Director

Date : 21/09/2018

Appendix 1. Abbreviations

| Abbreviations | Full texts |
|------------------|---|
| AOR | Ammonia oxidation reactor |
| 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 _{2e} | Carbon dioxide equivalent |
| DCS | Distributed Control System |
| DOE | Designated Operational Entity |
| FAR | Forward Action Request |
| GC | Gas chromatography |
| GHG | Greenhouse gas(es) |
| GWP | Global Warming Potential |
| IPCC | Intergovernmental Panel on Climate Change |
| KFQ | Korean Foundation for Quality |
| KTL | Korean Testing Laboratory |
| LPG | Liquefied Petroleum Gas |
| MoC | Modalities of Communication |
| MP | Monitoring Plan |
| MR | Monitoring Report |
| NA | Nitric Acid |
| N ₂ O | Nitrous oxide |
| PDD | Project Design Document |
| PP | Project participant |
| PS | Clean Development Mechanism Project Standard |
| QMS | Quality Management System |
| SCR | Selective catalytic reduction |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VVS | Clean Development Mechanism Validation and Verification Standard |

Appendix 2. Competence of team members and technical reviewers



CERTIFICATE OF COMPETENCE

Name: 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
- 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 31 March 2016

Sustainability Management Institute
Sang Yeon PARK



CERTIFICATE OF COMPETENCE

Name: Mi Jung LEE

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

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

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

Sustainability Management Institute
Yu Shim JEONG



CERTIFICATE OF COMPETENCE

Name: Yu Shim JEONG

Qualification:

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

Scopes of Expertise:

Technical Area (TA)

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

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

Sustainability Management Institute
Sang Yeon PARK

Appendix 3. Documents reviewed or referenced

| No. | Author | Title | References to the document | Provider |
|-----|----------------------|--|---|----------------------|
| 1 | Project participants | Monitoring report: Version 1.0: HUC-0765_MP38_MR v 01.0 Version 1.1: HUC-0765_MP38_MR v 01.1 | From 17/08/2018 From 14/09/2018 | Project participants |
| 2 | Project participants | CDM Project MS Excel Spreadsheet : Version 1.0: <ul style="list-style-type: none"> • HUC-0765_II_MP38_UNFCCC_v1.0_CONFIDENTIAL • HUC-0765_III_MP38_UNFCCC_v1.0_CONFIDENTIAL • HUC-0765_IV_MP38_UNFCCC_v1.0_CONFIDENTIAL • HUC-0765_ALL_MP38_UNFCCC_v1.0_CONFIDENTIAL | All from 17/08/2018 | Project participants |
| 3 | Project participants | Shewhart control charts / QAL 3 records | From 07/05/2018 to 05/08/2018 | Project participants |
| 4 | Delta V / DCS System | Daily reports (PDF files, CSV files), Data trend curves | From 07/05/2018 to 05/08/2018 | Project participants |
| 5 | Delta V / DCS System | Daily event log files (TXT files) | From 07/05/2018 to 05/08/2018 | Project participants |
| 6 | Project participants | CDM Project Design Document (Version 4.2) for the “Catalytic N2O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” (Renewal of the crediting period) | 18/12/2017 Published under: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1163081212.47/CP/FAZXN6VQ7XXO5PF73E0MV6184C5JF7/view | Others |
| 7 | TUV NORD | Validation Report for the “Catalytic N2O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” project. Report No. 800420315-13/095 (Renewal of the crediting period) | 07/11/2013 Published under: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1163081212.47/view | Others |
| 8 | KFQ | PRC Validation report version 01.0 date of 20/12/2017 | 20/12/2017 Published under: https://cdm.unfccc.int/PRCContainer/DB/prcp24361271/view | Others |
| 9 | KFQ | Verification/Certification Report for the “Catalytic N2O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.” for the monitoring period from 04/02/2018 to 06/05/2018 (Version 01.1) | 13/06/2018 Published under: http://cdm.unfccc.int/Projects/DB/TUEV-SUED1163081212.47/CP/FAZXN6VQ7XXO5PF73E0MV6184C5JF7/Process/KFQ1526258755.97/view | Others |
| 10 | Hu-Chems & UHDE GmbH | Nitric acid plant Hu-Chems IV operation manual (Capacity) Nitric acid plant Hu-Chems III operation manual (Capacity) Udhe designed capacity Hu-Chems II, III | From 21/03/2014 From September 2016 From 20/07/2006 | Project participants |
| 11 | Project participants | Equipment list and specifications for all monitoring equipment and analysers: | All from 05/08/2018 | Project participants |

| | | | | |
|----|---|---|--|----------------------|
| | | <ul style="list-style-type: none"> Plant Hu-Chems II Plant Hu-Chems III Plant Hu-Chems IV | | |
| 12 | Emerson Process Management | Instruction Manual – NGA 2000 for MLT Analyser (8 th Edition) | From August 2004 | Project participants |
| 13 | UHDE GmbH TÜEV Nord | Performance Guarantee Test Run (PGTR) protocols <ul style="list-style-type: none"> Plant Hu-Chems II Plant Hu-Chems III Plant Hu-Chems IV TÜEV Nord PGTR Certificates <ul style="list-style-type: none"> Plant Hu-Chems II Plant Hu-Chems III Plant Hu-Chems IV | From 02/04/2007 From 04/04/2007 From 16/01/2007 From 09/04/2007 From 09/04/2007 From 20/01/2007 | Project participants |
| 14 | AIRGAS AIRGAS AIRGAS | Calibration gas records (for plant Hu-Chems II) <ul style="list-style-type: none"> CC504647 / 1% Stability / Expiration on 11/08/2020 Calibration gas records (for plant Hu-Chems III) <ul style="list-style-type: none"> CC498342 / 1% Stability / Expiration on 25/09/2018 Calibration gas records (for plant Hu-Chems IV) <ul style="list-style-type: none"> CC467596 / 1% stability / Expiration on 22/03/2019 | From 11/08/2017 From 25/09/2017 From 22/03/2018 | Project participants |
| 15 | EPMK & Hu-Chems | Service Support Agreements: Delta-V system for EnviNOx® Hu-Chems as well as for Analyser systems for EnviNOx Hu-Chems between Hu-Chems Fine Chemical Corp. and Emerson Process Management Korea Ltd. | From 02/04/2013 | Project participants |
| 16 | EPMK | Regular service reports: <ul style="list-style-type: none"> Monthly Health Check report May 2018 Monthly Health Check report June 2018 Quarterly inspection & Monthly Health Check report July 2018 | From 18/05/2018 From 22/06/2018 From 20/07/2018 | Project participants |
| 17 | EMERSON | Instrumentation general maintenance reports <ul style="list-style-type: none"> Plant Hu-Chems II Plant Hu-Chems III Plant Hu-Chems IV | From 24/08/2017 From 26/07/2018 From 17/04/2018 | Project participants |
| 18 | Hu-Chems | CDM Analyser cabinet check lists (Shift) & key list CDM Check sheets of EnviNOx system (daily) | From 07/05/2018 to 05/08/2018 | Project participants |
| 19 | Hu-Chems | List of spare parts of monitoring system including provisions for re-purchasing. | From 31/07/2018 | Project participants |
| 20 | TÜV Rheinland Energie und Umwelt GmbH AIRTEC TÜV Rheinland Energie und Umwelt GmbH AIRTEC FM Tech | Instrument records & certificates (Hu-Chems Plant II) <ul style="list-style-type: none"> N₂O Outlet Analyser (322-AT-2-0127) – QAL1 Certification Statement N₂O Outlet Analyser (322-AT-2-0127) – QAL2 Test Certification (Performed on 27 to 29/09/2017, valid until 26/09/2022) Tail gas flow meter (322-FT-2-522) – QAL1 Certification Statement Tail gas flow meter (322-FT-2-522) – QAL2 Test Certification (performed on 27 to 29/09/2017, valid until 26/09/2022) Propane flow meter (322-FT-2-5121) – Korean Laboratory Accreditation Scheme (KOLAS) Calibration Certificate (performed on 18/08/2017, valid until 17/08/2022) | From 05/03/2018 From 10/11/2017 From 05/03/2018 From 10/11/2017 From 18/08/2017 | Project participants |

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|----|--|---|-----------------|----------------------|
| | FM Tech | <ul style="list-style-type: none"> Nitric acid production flow meter (322-FT-2-512) – (performed on 12/08/2016, valid until 11/08/2021) | From 12/08/2016 | |
| | EPMK | <ul style="list-style-type: none"> Nitric acid temperature converter (322-TI-2-127) – Calibration Certificate (performed on 23/08/2017, valid until 22/08/2021) | From 23/08/2017 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow differential pressure transmitter (322-FT-2-503) – Calibration Certificate (performed on 24/08/2017, valid until 23/08/2021) | From 24/08/2017 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow pressure transmitter (322-PT-2-303) – Calibration Certificate (performed on 24/08/2017, valid until 23/08/2021) | From 24/08/2017 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow temperature transmitter (322-TT-2-103) – Calibration Certificate (performed on 24/08/2017, valid until 23/08/2021) | From 24/08/2017 | |
| 21 | TÜV Rheinland Energie und Umwelt GmbH AIRTEC | <p>Instrument records & certificates (Hu-Chems Plant III)</p> <ul style="list-style-type: none"> N2O Outlet Analyser (323-AT-3-0127) – QAL1 Certification Statement | From 05/03/2018 | Project participants |
| | AIRTEC | <ul style="list-style-type: none"> N2O Outlet Analyser (323-AT-3-0127) – QAL2 Test Certification (performed on 06 to 08/09/2016, valid until 05/09/2021) | From 05/10/2016 | |
| | TÜV Rheinland Energie und Umwelt GmbH AIRTEC | <ul style="list-style-type: none"> N2O Outlet Analyser (323-AT-3-0127) – AST Certification (performed on 31/08-01/09/2017) Tail gas flow meter (323-FT-3-522) - QAL1 Certification Statement | From 21/11/2017 | |
| | AIRTEC | <ul style="list-style-type: none"> Tail gas flow meter (323-FT-3-522) – QAL2 Test Certification (performed on 06 to 08/09/2016, valid until 05/09/2021) | From 05/03/2018 | |
| | FM Tech | <ul style="list-style-type: none"> Tail gas flow meter (323-FT-3-522) – AST Certification (performed on 31/08 – 01/09/2017) | From 05/10/2016 | |
| | FM Tech | <ul style="list-style-type: none"> Propane flow meter (323-FT-3-5121) – Korean Laboratory Accreditation Scheme (KOLAS) Calibration Certificate (performed on 12/08/2016 valid until 11/08/2021) | From 21/11/2017 | |
| | EPMK | <ul style="list-style-type: none"> Nitric acid production flow meter (323-FT-3-512) Korean Laboratory Accreditation Scheme (KOLAS) – Calibration Certificate (performed on 18/08/2017, valid until 17/08/2022) | From 12/08/2016 | |
| | EPMK | <ul style="list-style-type: none"> Nitric acid temperature converter (323-TI-3-127) – Calibration Certificate (performed on 17/08/2016, valid until 16/08/2020) | From 18/08/2017 | |
| | EPMK | <ul style="list-style-type: none"> Nitric acid temperature converter (323-TI-3-127) – Calibration Certificate (performed on 26/07/2018, valid until 25/07/2022) | From 17/08/2016 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow differential pressure transmitter (323-FT-3-503) – Calibration Certificate (performed on 17/08/2016, valid until 16/08/2020) | From 26/07/2018 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow differential pressure transmitter (323-FT-3-503) – Calibration Certificate (performed on 25/07/2018, valid until 24/07/2022) | From 17/08/2016 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow pressure transmitter (323-PT-3-303) – Calibration Certificate (performed on 17/08/2016, valid until 16/08/2020) | From 25/07/2018 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow pressure transmitter (323-PT-3-303) – Calibration Certificate (performed on 27/07/2018, valid until 26/07/2022) | From 17/08/2016 | |
| | EPMK | <ul style="list-style-type: none"> AOR Ammonia flow temperature transmitter (323-TT- | From 27/07/2018 | |
| | | | From 17/08/2016 | |

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|----|--|---|--|-----------------------------|
| | <p>EPMK</p> <p>EPMK</p> | <p>3-103) – Calibration Certificate (performed on 17/08/2016, valid until 16/08/2020)</p> <ul style="list-style-type: none"> AOR Ammonia flow temperature transmitter (323-TT-3-103) – Calibration Certificate (performed on 26/07/2018, valid until 25/07/2022) | <p>From 26/07/2018</p> | |
| 22 | <p>TÜV Rheinland Energie und Umwelt GmbH AIRTEC</p> <p>TÜV Rheinland Energie und Umwelt GmbH AIRTEC</p> <p>Micro Motion, Inc.</p> <p>EPMK</p> <p>FM Tech</p> | <p>Instrument records & certificates (Hu-Chems Plant IV)</p> <ul style="list-style-type: none"> N2O Outlet Analyser (324-AT-4-0107) – QAL1 Certification Statement N2O Outlet Analyser (324-AT-4-0107) – QAL2 Test Certification (performed on 28 – 30/08/2017, valid until 27/08/2022) Tail gas flow meter (324-FT-4-522) – QAL1 Certification Statement Tail gas flow meter (324-FT-4-522) – QAL2 Test Certification (performed on 28 – 30/08/2017, valid until 27/08/2022) Nitric acid production flow meter (324-FT-4-609) – Micro Motion, Inc. Calibration Certificate (performed on 18/10/2017, valid until 17/10/2022) Nitric acid temperature transmitter (324-TT-4-237) – Calibration Certificate (performed on 17/04/2018, valid until 16/04/2022) AOR Ammonia flow meter (324-FT-4-5020) – Korean Laboratory Accreditation Scheme (KOLAS) Calibration Certificate (performed on 27/05/2014, valid until 26/05/2019) | <p>From 05/03/2018</p> <p>From 18/11/2017</p> <p>From 05/03/2018</p> <p>From 18/11/2017</p> <p>From 18/10/2017</p> <p>From 17/04/2018</p> <p>From 27/05/2014</p> | <p>Project participants</p> |
| 23 | <p>AIRTEC</p> <p>AIRTEC</p> <p>AIRTEC</p> <p>AIRTEC</p> | <p>Hu-Chems Plant II</p> <ul style="list-style-type: none"> QAL 2 Test Certification Report (performed on 27/09/2017~29/09/2017), including moisture content measurement records & reports <p>Hu-Chems Plant III</p> <ul style="list-style-type: none"> QAL 2 Test Certification Report (performed on 06/09/2016~08/09/2016), including moisture content measurement records & reports AST Report (performed on 31/08/2017 to 01/09/2017), including moisture content measurement records & report <p>Hu-Chems Plant IV</p> <ul style="list-style-type: none"> QAL 2 Test Certification Report (performed on 28/08/2017~30/08/2017), including moisture content measurement records & reports | <p>From 10/11/2017</p> <p>From 05/10/2016</p> <p>From 21/11/2017</p> <p>From 18/11/2017</p> | <p>Project participants</p> |
| 24 | <p>European Committee for Standardization (CEN)</p> | <p>EN 14181:2014 – Stationary source emissions – Quality assurance of automated measuring systems</p> | <p>From November 2014</p> | <p>Others</p> |
| 25 | <p>Hu-Chems</p> | <p>Quality Management System (QMS) Documents</p> <ul style="list-style-type: none"> CDM Operation Management Procedure (HFC-I-EP0448, Rev. 5) CDM Procedures for environment operation management (HFC-I-EP0446, Rev. 4) CDM Social Fund Commitment (HCSI-448, Rev. 2) | <p>From 12/06/2014</p> <p>From 12/06/2014</p> <p>From 12/03/2012</p> | <p>Project participants</p> |
| 26 | <p>DeaYoung Energy Co.</p> | <p>Invoice of LPG</p> <p>Invoice of LPG</p> <p>Invoice of LPG</p> | <p>From 31/05/2018</p> <p>From 30/06/2018</p> <p>From 31/07/2018</p> | <p>Project participants</p> |

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|----|--------------------------------|---|--|----------------------|
| | Hu-Chems | Propane Balance NA Plant II & III | From 07/05/2018 to 05/08/2018 | |
| 27 | Hu-Chems & ShinHan Bank | Balance sheets and transaction evidence for CDM contribution to Social Fund for all years from 2007 – 2017 | From 31/12/2017 | Project participants |
| 28 | Hu-Chems | Hu-Chems Training records & Training documents | From 2018 | Project participants |
| 29 | Hu-Chems | Report on environmental regulations (N ₂ O and NO _x): <ul style="list-style-type: none"> From May 2018 From June 2018 From July 2018 | From 31/05/2018 From 30/06/2018 From 31/07/2018 | Project participants |
| 30 | Korean Foundation for Quality | <ul style="list-style-type: none"> ISO 9001:2009 Certificate, issued on 01/09/2017, valid until 14/09/2018 ISO 14001:2009 Certificate, issued on 01/09/2017, until 14/09/2018 | From 01/09/2017 From 01/09/2017 | Project participants |
| 31 | Hu-Chems | Internal audit records 2017 | From 28/06/2017 | Project participants |
| 32 | Ministry of Environment | Clean Air Conservation Act of the Republic of Korea | From 18/01/2018 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 |
| 33 | Ministry of Environment | Framework Act on Low Carbon, Green Growth | From 31/10/2013 Published under: http://www.law.go.kr/lsInfoP.do?lsiSeq=142380#0000 | Others |
| 34 | Ministry of Environment | Act on the Allocation and Trading of Greenhouse gas Emission Permits Notification on emission allocation to Hu-Chems Fine Chemical Corp. | From 23/03/2013 Published under: http://www.law.go.kr/LSW/lsInfoP.do?lsiSeq=137271#0000 From 01/12/2014 | Others |
| 35 | Ministry of Knowledge, Economy | Letter, confirming that Hu-Chems plants do not have an obligation from the relevant environmental regulations (Energy & GHG Target Scheme) | From 21/10/2011 | Project participants |
| 36 | Ministry of Knowledge, Economy | Energy Law Enforcement Rule | From 28/12/2017 Published under: http://www.law.go.kr/lsSc.do?menuId=0&subMenu=1&query=%EC%97%90%EB%84%88%EC%A7%80%EB%B2%95%20%EC%8B%9C%ED%96%89%EA%B7%9C%EC%B9%99#undefined | |
| 37 | CDM Executive Board | Methodology and Tools <ul style="list-style-type: none"> Methodology ACM0019 “N₂O abatement from nitric acid production” (Version 02) Tool to determine the mass flow of a greenhouse gas | From 31/05/2013 From 27/11/2015 | Others |

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|--|--|--|---|--|
| | | in a gaseous steam (version 3.0) • Tool to calculate project or leakage CO2 emission from fossil fuel combustion (version 03.0) | From 22/09/2017 Published under: http://cdm.unfccc.int/methodologies/DB/MNMFNF10VUEOJACEIRX3EHYC9QXGDC | |
| | | Standards, Procedures & Checklists • Standard – CDM validation and verification standard for project activities (Version 01.0) • Standard – CDM project standard for project activities (Version 01.0) • Standard – Sampling and surveys for CDM project activities and programme of activities (Version 07) • Procedure – CDM project cycle procedure for project activities (Version 01.0) • Guideline – Application of materiality in verifications (Version 02.0) • Checklist – Checklist for requests for issuance for project activities (Version 01.0) • Form - Monitoring report form (Version 06.0) • Form - Verification and certification report form for CDM project activities (Version 02.1) | From 03/03/2017 From 03/03/2017 From 04/05/2017 From 03/03/2017 From 20/02/2015 From 30/08/2017 From 07/06/2017 From 11/01/2018 All published under: http://cdm.unfccc.int/Reference/index.html | |

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

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

| FAR ID | 01 | Section no. | E.2 | Date: 13/09/2018 |
|--|----|-------------|-----|-------------------------|
| Description of FAR | | | | |
| In accordance with paragraph 62(g) of the CDM Modalities and Procedure, the DOE contracted by the project participant to perform verification shall, "Identify and inform the project participants of any concerns related to the conformity of the actual project activity and its operation with the registered project design document. Project participants shall address the concerns and supply relevant additional information;" Hu-Chems is mandatory participant of the Greenhouse Gas and Energy Target Scheme and thus, the new nitric acid plant is one GHG emission source which has also been reported to the authority for target setting. The validation opinion is based on the current laws and regulations which are described in Validation Report. Any change of the Greenhouse Gas and Energy Target Scheme or other legislation which affects the project activity's emission reduction under CDM should be assessed by the verifying DOE. During verification of MPs in CP 2 the implementation of the Korean ETS and its consequences for the plant shall be observed and considered to avoid double counting of emission reductions. | | | | |
| Project participant response | | | | Date: 14/09/2018 |
| Hu-Chems Environmental team regularly checks, if any regulation on N ₂ O limitation is in place (relevant laws are the Clean Air Conservation Act and the Framework Act on Low Carbon, Green Growth). The relevant Acts show that no regulation of N ₂ O limitation is in place which would restrict the emission of N ₂ O in Hu-Chems nitric acid plant #2~#4. In addition, Korea government has started Korean ETS since 01/01/2015 as per the Act on the Allocation and Trading of Greenhouse-gas Emission Permits (13/03/2013). According to the Act, Hu-Chems Fine Chemical Corp. is designated as allocation entity, and there was a notification received from the Ministry of Environment that CDM projects are exempted from allocation. Thus, Hu-Chems nitric acid plants 2 ~ 4 have no obligation to reduce its N ₂ O emissions and there is no double counting of emission reductions due to Korean ETS. | | | | |
| Documentation provided by project participant | | | | |
| The Clean Air Conservation Act (from 2013 to 2018 latest version in January 2018) The Framework Act on Low Carbon, Green Growth (latest version in Dec. 2013) Act on the Allocation and Trading of Greenhouse-gas Emission Permits (latest version in Mar. 2013) The confirmation letter from the Ministry of Knowledge and Economy (21/10/2011) Notification on emissions allocation to Hu-Chems Fine Chemical Corp. by the ministry of environment (01/12/2014) | | | | |
| DOE assessment | | | | Date: 18/09/2018 |
| In addition to reviewing the latest reports by the Hu-Chems Environmental team, KFAQ checked the relevant Korean environmental regulations including such, which could impact N ₂ O emissions. In April 2010, new Korean regulations became effective (The Framework Act on Low Carbon, Green Growth), introducing the GHG and Energy Target Scheme. Hu-Chems nitric acid plant #2~#4 does not have any target obligation on GHG emissions from this GHG and Energy Target Scheme. This was verified by the confirmation letter from the Ministry of Knowledge and Economy. The verification team have also checked Korean ETS has started since 01/01/2015 as per the Act on the Allocation and Trading of Greenhouse-gas Emission Permits. It was verified that CDM projects are exempted from allocation in Korean ETS through the notification on emissions allocation to Hu-Chems Fine Chemical Corp. by the Ministry of Environment. Thus, it is concluded that Hu-Chems nitric acid plant #2~#4 have no obligation to reduce its N ₂ O emissions, and there is no double counting of emission reductions for Hu-Chems nitric acid plant #2~#4 due to Korean ETS. KFAQ confirms, that there are currently no restrictions related to N ₂ O emissions which have impact on the project activity and emission reduction calculations. | | | | |

Table 2. CL from this verification

| CL ID | 01 | Section no. | B.1 | Date: 13/09/2018 |
|--|----|-------------|-----|-------------------------|
| Description of CL | | | | |
| According to the operational records such as daily report, CDM charts and ER calculation spreadsheet of Hu-Chems II, NA plant shutdown period during this monitoring period is from 03:00 on 20/05/2018 to 21:00 on 20/05/2018 but it wrongly stated in section B.1 of the monitoring report version 01.0. | | | | |
| Project participant response | | | | Date: 14/09/2018 |
| PP revised MR to report correct duration of Hu-Chems II NA plant shutdown | | | | |

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|---|-------------------------|
| Documentation provided by project participant | |
| MR (v.01.1) | |
| DOE assessment | Date: 18/09/2018 |
| PP revised MR (v.01.1) to report correct shutdown period of Hu-Chems II NA plant during this monitoring period and the verification team confirmed that it is consistent with internal documents as well as interview with project management and operations are conducted. | |

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|---|----|--------------------|-----|-------------------------|
| CL ID | 02 | Section no. | B.1 | Date: 13/09/2018 |
| Description of CL | | | | |
| Fluctuation of N2O concentration at Hu-Chems IV from 13:00~16:00 on 29/06/2018 was occurred but reason of it is not clearly provided in the monitoring report version 01.0. | | | | |
| Project participant response | | | | Date: 14/09/2018 |
| PP revised MR to provide better explains the reason of the fluctuation in N2O concentration at Hu-Chems IV. | | | | |
| Documentation provided by project participant | | | | |
| MR (v.01.1) | | | | |
| DOE assessment | | | | Date: 18/09/2018 |
| PP revised MR (v.01.1) to provide better explains the reason of fluctuation in N2O concentration at Hu-Chems IV from 13:00~16:00 on 29/06/2018. It was occurred due to outlet analyzer vent line was clogging by NOx gas and the verification team checked it through service report issued on 02/07/2018 and internal operation records such as CDM charts and daily reports. Thus verification team concluded that clear explanation regarding N2O concentration fluctuation at Hu-Chems IV from 13:00~16:00 on 29/06/2018. | | | | |

Table 3. CAR from this verification

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|--|-----|--------------------|-----|------------------|
| CAR ID | n/a | Section no. | n/a | Date: n/a |
| Description of CAR | | | | |
| n/a | | | | |
| Project participant response | | | | Date: n/a |
| n/a | | | | |
| Documentation provided by project participant | | | | |
| n/a | | | | |
| DOE assessment | | | | Date: n/a |
| n/a | | | | |

Table 4. FAR from this verification

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|--|-----|--------------------|-----|------------------|
| FAR ID | n/a | Section No. | n/a | Date: n/a |
| Description of FAR | | | | |
| n/a | | | | |
| Project participant response | | | | Date: n/a |
| n/a | | | | |
| Documentation provided by project participant | | | | |
| n/a | | | | |
| DOE assessment | | | | Date: n/a |
| n/a | | | | |