VERIFICATION / CERTIFICATION REPORT

CATALYTIC N2O ABATEMENT PROJECT IN THE TAIL GAS OF THE NITRIC ACID PLANT OF THE PAKARAB FERTILIZER LTD. (PVT) IN MULTAN, PAKISTAN

UNFCCC REGISTRATION NR.0557

MONITORING AND REPORTING PERIOD:

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DET NORSKE VERITAS

VERIFICATION / CERTIFICATION REPORT

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Approved by: Michael Lehmann Technical Director	Organisational unit: Climate Change Services
Client: Mitsubishi Corporation	Client ref.: Masataka Shimazu

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Summary:

Det Norske Veritas Certification AS has been contracted by Mitsubishi Corporation to carry out verification and certification of emission reductions reported for the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Ltd. (PVT) in Multan, Pakistan" (UNFCCC Ref. No. 0557) for the period 1 April 2008 to 31 July 2008.

In our opinion, the reported emission reductions for the period from 1 April 2008 to 31 July 2008, as reported in the monitoring report, version 01 of 22 August 2008, are fairly stated. Some revisions were done to the initial monitoring report of 8 August 2008 due to the project participant's response to CAR/FAR's raised during the verification and due to minor typing errors.

The emission reductions were calculated correctly on the basis of the approved monitoring methodology AM0028 version 01, the revised monitoring plan approved on 3 December 2007 and the registered project design document. Det Norske Veritas Certification is able to certify that the emission reductions from the project during the period 1 April 2008 to 31 July 2008 amount to 392 606 tonnes of CO_2 equivalents.

Report No.: 2008-9185	Subject Group: Environment	
Report title: Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Ltd. (PVT) in Multan, Pakistan		
Work carried out by: Akira Sekine, Venkata Raman Kakaraparthi		
Work verified by: Trine Kopperud		
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Indexing terms

Key words Climate Change Kyoto Protocol Verification Clean Development Mechanism	Service Area Verification Market Sector Process Industry

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Abbreviations

AMS	Automated Monitoring System
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DNV	Det Norske Veritas
DNA	Designated National Authority
DOE	Designated Operational Entity
FAR	Forward Action Request
GHG	Greenhouse gas(es)
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
N_2O	Nitrous oxide
NDIR	Non-dispersive Infrared Spectrometer
NGO	Non-governmental Organisation
ODA	Official Development Assistance
PDD	Project Design Document
QMS	Quality Management System
UNFCCC	United Nations Framework Convention for Climate Change
GWP	Global Warming Potential

1 INTRODUCTION

Det Norske Veritas Certification AS (DNV) has been contracted by Mitsubishi Corporation to carry out verification and certification of the emission reductions reported for the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Ltd. (PVT) in Multan, Pakistan" (hereafter the project) for the period 1 April 2008 to 31 July 2008. This report contains the findings from this verification assignment and a certification statement for the certified emission reductions.

The verification team consisted of the following personnel:

Akira Sekine	DNV Japan	Team leader, CDM verifier
Venkata Raman Kakaraparthi	DNV India	Sector expert
Trine Kopperud	DNV Norway	Technical reviewer

1.1 Objective

DNV has been engaged by Mitsubishi Corporation to verify and certify the emission reductions reported for the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Ltd. (PVT) in Multan, Pakistan" for the period from 1 April 2008 to 31 August 2008, equating to 392 606 tonnes of CO_2 equivalents.

Verification is the periodic independent review and *ex post* determination by the Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the a registered CDM project activity during a defined verification 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.

1.2 Scope

The verification scope is:

- To verify that actual monitoring systems and the procedures are in compliance with the monitoring systems and procedures described in the monitoring plan.
- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement.
- To verify that the reported GHG emission data is sufficiently supported by evidence, i.e. monitoring records.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

The verification team has, based on the recommendations in the Validation and Verification Manual /6/, and employed a risk-based approach, focusing on the identification of significant reporting risks.

1.3 Description of the Project Activity

Project Parties:	*Pakistan (Host) and Japan*
Title of project activity:	*Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Ltd. (PVY) in Multan, Pakistan.*
UNFCCC registration No:	*UNFCCC registration No. 0557*
Project Entity:	*Mitsubishi Corporation* *Address: 16-3, Konan 2-chome, Minato-ku, Tokyo, Japan* *Contact person: Masataka Shimazu;* *Telephone: +81 (3) 6405-4496* *Pakarab Fertilizer, Ltd.* *Address: 2nd Floor, Trust Plaza, L. M. Q. Road, Multan, Pakistan* *Telephone: +92 (51) 512031*
Location of the project activity:	*The project is located in L.M.Q. Road, Multan, Punjab Province of Pakistan.*

The project has been in operation in this facility since April 2007, and was registered on 5 November 2006. The project covers three nitric acid plants (Line A, B and C) and the start-up date for the project activity was as follows:

Pakarab nitric acid plant "Line A":
Start-up date: 19 April 2007
Number of days in this monitoring period: 122 (number of operating days is 119 days)

Pakarab nitric acid plant "Line B":
Start-up date: 3 September 2007
Number of days in this monitoring period: 122 (number of operating days is 118 days)

Pakarab nitric acid plant "Line C":
Start-up date: 5 March 2008
Number of days in this monitoring period: 122 (number of operating days is 114 days)

The project has installed tertiary N_2O reduction technology in the tail gas stream of the three nitric acid production plant of the Pakarab Fertilizer Ltd. (PVT) in Multan, Pakistan. Nitrous oxide, formed as a by-product of the nitric acid production, is removed by three Catalytic De-N_2O systems provided by N. E. Chemcat (catalyst) and Sumiko Eco-Engineering (engineering). Natural gas is used to re-heat the tail gas to obtain optimal abatement temperature at the De-N_2O reactors.

The selective catalytic reduction (SCR) reactors are newly installed in the three nitric acid plants together with Catalytic De-N_2O System in order to reduce nitrogen oxides (NO_X) emission. Ammonia is used as a reducing agent in this process.

The tail gas from the nitric acid facilities are fed into the catalytic De-N_2O systems and the nitrous oxide is reduced approximately 90% according to the ex-ante emission reduction estimations /2/. The stack gas volume flow and the nitrous oxide concentration inlet and outlet of the catalytic De-N_2O systems are monitored and recorded. The amounts of natural gas used in the catalytic abatement systems are monitored in order to calculate the non-N_2O emissions of the project activity.

The emission reductions reported from the project for the period from 1 April 2008 to 31 August 2008 equate to 392 606 tonnes of CO_2 equivalents.

2 METHODOLOGY

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. As the CDM Executive Board has not yet formally endorsed the application of any materiality principle for verification of emission reductions from CDM projects - implying that emphasis should be on the significant contributors to emission reductions - DNV has for this assignment checked all factors and issues with the same emphasis. Despite this, DNV 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. All relevant records of data from the Catalytic De-N_2O Systems and records from the production logs of the nitric acid production have been examined and verified for the reporting period.

The verification process was guided by a verification checklists (refer to Appendix A).

Duration of verification

Preparations:	*10 to 18 August 2008*
On-site verification:	*21 to 22 August 2008*
Reporting/QA*:*	*23 August to 5 September 2008 (corrected 8 October 2008)*

2.1 Review of Documentation

The basis for the verification has been the monitoring report /1/ from the project for the period 1 April 2008 to 31 July 2008, dated 8 August 2008, the revised monitoring report dated 22 August 2008, the registered project design document (PDD) /2/, the revised monitoring plan approved on 3 December 2007 /18/ and the approved baseline and monitoring methodology applied by the project, i.e. AM0028, version 1 /6/. The project operator has in addition supplied the verification team with procedures from its management system as well as other documentation and spreadsheets with all data necessary for verification of the emission reductions /3/, /4/, and /8/-/25/.

2.2 Site Visit

Detailed verification of all data contained in the monitoring report was performed during a site visit at Pakarab Fertilizer Ltd on 21 and 22 August 2008. During the site visit, the following personnel were interviewed or assisted the verification team:

Name	*Organization*	*Position*
Masataka Shimazu	Mitsubishi Corporation	Assistant General Manager, Emission Reduction Business Unit
Tariq Faiz	Pakarab Fertilizer Limited	Unit Manager, CDM Unit
Arif Maqsood	Pakarab Fertilizer Limited	Unit Manager, Nitric Acid Plant
Talah Sangi	Pakarab Fertilizer Limited	Process Engineer, CDM Unit
Saqib Ansari	Pakarab Fertilizer Limited	Instrument Engineer, CDM Unit
Muhammad Siddique	Pakarab Fertilizer Limited	Account Manager
Mughees-Ul Haque	Pakarab Fertilizer Limited	Instrument Engineer, Nitric Acid Plant
Rashid Saud	Pakarab Fertilizer Limited	Technician, Nitric Acid Plant
Zahoor Ahmad	Pakarab Fertilizer Limited	Technician, Nitric Acid Plant
Abdul Sattar	Pakarab Fertilizer Limited	Operator, Nitric Acid Plant
Hamid-ul-Rehman	Pakarab Fertilizer Limited	Operator, Nitric Acid Plant
Hafiz-ul-Rehman	Pakarab Fertilizer Limited	Operator, Nitric Acid Plant
Rasheed Hameed	Pakarab Fertilizer Limited	Operator, Nitric Acid Plant

2.2.1 Audit Programme

21 August 2008

10:00 Opening Meeting

10:30 Plant walk-through

- Location of the monitoring equipment
- Calibration laboratory
- Record keeping

11:30 Assessment of monitoring equipment and calibration procedures/records

- Stack gas flow meter and N_2O analyser
- Uncertainty of the automated measuring system (AMS)
- Ammonia oxidation monitoring equipment
- Operational logs for historical data and permitted operational ranges

16:00 Assessment of data monitored

17:30 End of the first day

22 August 2008

09:00 Confirmation of the remaining issues

11:00 Preparation for wrap-up

12:30 Wrap-up meeting and presentation of findings

13:30 End of the verification

2.3 Assessment

The data presented in the monitoring report was assessed by review of the detailed project documentation and production records, as well as by interviews with personnel of Pakarab Fertilizer Limited and Mitsubishi Corporation, by 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 the reported monitoring results; to verify the correct application of the approved monitoring methodology and the determination of the reductions in N_2O emissions.

In addition all parameters required by the monitoring methodology AM0028 version 01, and the management system were assessed during the site visit.

2.4 Reporting of Findings

Findings established during the verification may be that:

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

i) the verification is not able to obtain sufficient evidence for the reported emission reductions or part of the reported emission reductions. In this case these emission reductions shall not be verified and certified;

ii) the verification has identified material misstatements in the reported emission reductions. Emission reductions with material misstatements shall be discounted based on the verifiers ex-post determination of the achieved emission reductions.

A forward action request (FAR) may be issued, where:

- the actual project monitoring and reporting practices requires attention and /or adjustment for the next consecutive verification period, or
- an adjustment of the monitoring plan is recommended.

In the context of FARs, risks have been identified, which may endanger the delivery of CERs in the future, i.e. by deviations from standard procedures as defined by the monitoring plan. As a consequence, such aspects should receive a special focus during the next consecutive verification. A FAR may originate from lack of data sustaining claimed emission reductions.

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the project "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plant of the Pakarab Fertilizer Limited (PVT) in Multan, Pakistan" for the period 1 April to 31 July 2008.

3.1 Remaining Issues, CARs, FARs from Previous Validation or Verification

There are no remaining issues from the validation of the project /7/. Among the seven "Forward Action Requests (FAR)" from the first periodic verification, the remaining FAR 1, 2, 5 and 6 were verified to be resolved. Further the remaining FAR from the second verification, FAR 2, was also verified to be resolved. Hence all remaining FARs from previos verifications are closed, see chapter 3.8.

3.2 Project Implementation

The project was implemented as described in the registered PDD. During the on-site visit the verification team inspected the installation of the Regenerative Catalytic System and all instrumentation necessary for the monitoring of the emission reductions.

The project is implemented and has been in operation since 19 April 2007 for Pakarab Fertilizer Limited Nitric Acid Plant Line A. Guarantee test runs were performed in January 2007 confirming all guarantee figures were met.

The project activity of Line B started 3 September 2007 and the project activity of Line C started this monitoring period on 5 March 2008.

3.3 Completeness of Monitoring

The monitoring of the project is complete and in accordance with the approved monitoring methodology. All main parameters stated in the revised monitoring plan are monitored and reported appropriately. The monitoring methodologies and sustaining records are sufficient to enable verification of emission reductions. National regulation of NO_X emissions is included in the revised monitoring report.

3.4 Assessment of Monitoring Parameters

3.4.1 Permitted operating conditions

In order to avoid that the operation of the nitric acid production plant is manipulated in a way to increase the N_2O generation, and thereby increasing the CERs, the ammonia flow, operating temperature and pressure in the ammonia oxidation reactor and the use of ammonia oxidation catalyst is monitored and compared to the historical values as determined in the PDD.

If a permissible operating limit is exceeded, the baseline N_2O emissions for that period shall be capped at the conservative IPCC default value of **4.05 kg-N_2O/t-HNO_3**.

The verification team has assessed the operating conditions for the verification period.

The historical data for the three ammonia oxidation reactors (temperatures, pressures and ammonia flow rate) of Line A - C are taken from the actual historical record of the Pakarab Fertilizer Limited nitric acid plants. The information regarding the manufacturer and the type of ammonia oxidation catalyst is taken from the proposals and the invoices issued by the catalyst supplier Johnson & Matthey /13/:

Pakarab Line A:

Tg,hist Historical operating temperature range AOR (°C) : 887-891
Pg,hist Historical operating pressure range AOR (Pa): 470719-529559 (4.80-5.40 kg/cm^2)
AOR,hist Historical ammonia input to oxidation reactor (tNH_3/day): max. 181
Gsup,hist Historical supplier of the ammonia oxidation catalyst: Johnson & Matthey
Gcom,hist Historical composition of the ammonia oxidation catalyst: 90% Pt, 10% Rh

Pakarab Line B:

Tg,hist Historical operating temperature range AOR (°C) : 888-891
Pg,hist Historical operating pressure range AOR (Pa): 490333-519752 (5.00-5.30 kg/cm^2)
AOR,hist Historical ammonia input to oxidation reactor (tNH_3/day): max. 181
Gsup,hist Historical supplier of the ammonia oxidation catalyst: Johnson & Matthey
Gcom,hist Historical composition of the ammonia oxidation catalyst: 90% Pt, 10% Rh

Pakarab Line C:

Tg,hist Historical operating temperature range AOR (°C) : 910-925
Pg,hist Historical operating pressure range AOR (Pa): 632530-774726 (6.45-7.90 kg/cm^2)
AOR,hist Historical ammonia input to oxidation reactor (tNH_3/day): max. 58
Gsup,hist Historical supplier of the ammonia oxidation catalyst: Johnson & Matthey
Gcom,hist Historical composition of the ammonia oxidation catalyst: 90% Pt, 10% Rh

The project and baseline emissions are limited to the design capacity of the existing nitric acid plant. If the actual production of nitric acid (P_HNO_3y) exceeds the design capacity (P_HNO_3, max.) then emissions related to the production above P_HNO_3, max will neither be claimed for the baseline nor for the project scenario. The design capacity as per 31 December 2005 for Pakarab Fertilizer Limited nitric acid plants are as follows /2/:

Pakarab, Line A: **219 000** t-HNO_3/yr (**600** t-HNO_3/day)
Pakarab, Line B: **219 000** t-HNO_3/yr (**600** t-HNO_3/day)
Pakarab, Line C: **65 700** t-HNO_3/yr (**180** t-HNO_3/day)

DNV evaluated the actual nitric acid production during the monitoring period compared with the maximum production during the same period as follows:

The number of days in the monitoring period was 122 days. The actual production of Line A during the period was 66 836 ton and is below the maximum limitation of 73 200 ton (600 t/day * 122 days). Similarly actual production of Line B during the period was 67 571 ton and this was below the maximum limitation of 73 200 ton (600 t/day * 122 days).

Moreover the production of Line A from 1 August 2007 to 31 July 2008 (366 days) were

177 181 ton and below a yearly capacity of 219 600 tons/yr (600 t/day * 366 days), similarly the production of Line B from 3 September 2007 to 31 July 2008 (333 days) were 176 504 ton and below the capacity of 199 800 tons (600 t/day * 333 days).

The nitric acid produced is constantly transferred into intermediate small nitric acid tanks of the respective production lines for sampling. Density measurement is conducted by the laboratory of the participant. The temperature of the nitric acid is monitored in the nitric acid line immediately after the flow meter. The flow rates are monitored by Krohne magnetic inductive flow meters. 100% nitric acid produced is determined from the density, temperature and concentration data. The verification team assessed the flow rate adjustment based on the data provided from the participant /25/. The nitric acid sample of a specific day is taken from the intermediate small tank at midnight everyday. The daily average concentration is obtained from the density measured by a hydrometer and the temperature of the sample. The concentration of the sample is determined using the conversion diagram provided from the engineering provider of the plant /24/. Further the density of the acid (flowing in the pipeline and through the flow meter) is determined from the temperature in the nitric acid line and the concentration of the sample by using the same diagram.
The verification team conducted crosschecking by sampling randomly picked days of the raw data (concentration, density, temperature and volume flow). For the verified period no material mistakes were observed in the reported values for 100% nitric acid produced (as reported in the production reports /25/). It was verified on-site that nitric acid values reported in the production reports were consistent with the values in the provided spreadsheets.

The recording in production logs, the calibration and maintenance routines for the below parameters are the responsibility of Pakarab Fertilizer Limited and the related procedures are incorporated into the existing QA/QC management system. The recorded values for the operating temperature and pressure for the operation, and ammonia inlet flow of the ammonia oxidation reactor are automatically transferred to the data management system (ABB EMS2000).

Line A:

Data variable	**Tag. No.**	**Reported value for the monitoring period**	**Assessment /Observation Description of monitoring equipment, measurement, calibration routines and uncertainty**
A_{ORd} Actual ammonia input to oxidation reactor (tNH3/day) *) reported in tons	**Line A: FT-02301A** Range: 0-1296 mm Aq (0-7.375 tNH_3/h)	Daily average: **Min.: 53** **Max. 177** Historical: Max 181 t/day	Ammonia flow meter, manufactured by Honeywell. The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 10 January 2008. (Calibration Procedure: ref. 05-16) The range is appropriate. Accuracy: ± 2% of span

			All daily recordings were found to be less than the permitted range.
Tg Actual operating temperature AOR on day d (°C)	**Line A: TE-02104A** Range: 0-1300 °C	**Min.: 889 °C** **Max.: 891 °C** Historical: 887-891°C	The temperature in the ammonia reactor is monitored by three thermocouples delivered by Thermo-electra model K-Type. The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 9 January 2008. (Calibration Procedure: INS-WI QMS-028) The range is appropriate. Accuracy: ± 2 °C All daily recordings were found to be within the permitted range.
Pg Actual operating pressure AOR on day d (kg/cm²)	**Line A: PG-AOR-Line A** Range: 0-10 kg/cm²	**Min.: 5.0** **Max.: 5.0** Historical: 4.8-5.4 kg/cm²	The pressure recorded for operational ammonia oxidation pressure is measured in the primary air supply line by the pressure gage. (Manufacture: Nuova Fima) The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 12 January 2008. (Calibration Procedure: INS-WI QMS-021) The range is appropriate. Accuracy: ± 2% of span All daily recordings were found to be within the permitted range.
Gsup Supplier of the ammonia oxidation catalyst	-	**Johnson Matthey** Historical: Johnson Matthey	The purchase document and shipping document were made available to verify the supplier /13/.
Gcom Composition of the ammonia oxidation catalyst	-	**90% Pt , 10% Rh** Historical: 90% Pt, 10% Rh	The purchase document and shipping document were made available to verify the composition /13/. Normal campaign length is 3 months.
P_HNO_3 Plant output of nitric acid	**Line A:** Flow meter: **FQ-02306A**	**66 836** tHNO_3 Average daily	The nitric acid flow is measured with a Vortex magnetic flow meter supplied by Krohne (SC-100AS).

$tHNO_3$	Transmitter: **FT-02306A** Range: 0-40 m^3/h	production is 547.8 Design Capacity: 600 $tHNO_3$/day	Accuracy: ± 2% of span The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration is done every 1 year. The latest calibration was conducted 20 January 2008 for the flow meter and 16 September 2007 for the temperature transmitter. (Calibration Procedure: Ref. 05-25) /12/. 100% nitric acid in tons is determined from the volume flow rate, density, concentration and temperature of the nitric acid (as described above). The production quantity during the period is below the design capacity of 73 200 $tHNO_3$ (for this monitoring period).

Line B:

Data variable	Tag. No.	Reported value for the monitoring period	Assessment /Observation Description of monitoring equipment, measurement, calibration routines and uncertainty
A_{ORd} Actual ammonia input to oxidation reactor (tNH_3/day) *) reported in tons	**Line B: FT-02301B** Range: 0-1296 mm Aq (0-7.375 tNH_3/h)	**Daily average: Min.: 92 Max. 181** Historical: Max 181 t/day	Ammonia flow meter, manufactured by Honeywell The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 23 January 2008. (Calibration Procedure: ref. 05-16) The range is appropriate. Accuracy: ± 2% of span All daily recordings were found to be less than the permitted range.
Tg Actual operating temperature AOR on day d (°C)	**Line B: TE-02104B** Range: 0-1300 °C	**Min.: 888 °C Max.: 890 °C** Historical: 887-891°C	The temperature in the ammonia reactor is monitored by three thermocouples delivered by Thermo-electra model K-Type. The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 10 January 2008. (Calibration Procedure: INS-WI QMS-028) The range is appropriate. Accuracy: ± 2 °C All daily recordings were found to be within the permitted range.
Pg Actual operating pressure AOR on day d (kg/cm^2)	**Line B: PG-AOR-Line B** Range: 0-10 kg/cm^2	**Min.: 5.0 Max.: 5.0** Historical: 5.0-5.3 kg/cm^2	The pressure recorded for operational ammonia oxidation pressure is measured in the primary air supply line by the pressure gage. (Manufacture: Nuova Fima) The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 14 January 2008. (Calibration Procedure: INS-WI

			QMS-021) The range is appropriate. Accuracy: ± 2% of span All daily recordings were found to be within the permitted range.
Gsup Supplier of the ammonia oxidation catalyst	-	**Johnson Matthey** Historical: Johnson Matthey	The purchase document and shipping document were made available to verify the supplier /13/.
Gcom Composition of the ammonia oxidation catalyst	-	**90% Pt , 10% Rh** Historical: 90% Pt, 10% Rh	The purchase document and shipping document were made available to verify the composition /13/. Normal campaign length is 3 months.
P_HNO_3 Plant output of nitric acid $tHNO_3$	**Line B:** Flow meter: **FQ-02306B** Transmitter: **FT-02306B** Range: 0-40 m^3/h	**67 571** $tHNO_3$ Average daily production is 553.9 Design Capacity: 600 $tHNO_3$/day	The nitric acid flow is measured with a Vortex magnetic flow meter supplied by Krohne (SC-100AS). Accuracy: ± 2% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 year. The latest calibration was conducted 18 January 2008 for the flow meter and 16 September 2007 for the temperature transmitter. (Calibration Procedure: Ref. 05-25) /12/. 100% nitric acid in tons is determined from the volume flow rate, density, concentration and temperature of the nitric acid (as described above). The hourly rate in m^3/h is automatically calculated by AMS. The nitric acid in tons is automatically adjusted from density/temperature of the acid by means of built-in adjustor. The production quantity during the period is below the design capacity of 73 200 $tHNO_3$ (for this monitoring period).

Line C:

Data variable	Tag. No.	Reported value for the monitoring period	Assessment /Observation Description of monitoring equipment, measurement, calibration routines and uncertainty
AORd Actual ammonia input to oxidation reactor (tNH_3/day) *) reported in tons	**Line C:** **FT-07** **304C** Range: 0-2500 mm Aq (0-7.375 tNH_3/h)	**Daily average:** **Min.: 7** **Max. 53** Historical: Max 58 t/day	Ammonia flow meter, manufactured by Yamatake-Honeywell The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 11 January 2008. (Calibration Procedure: ref. 05-16) The range is appropriate. Accuracy: ± 2% of span All daily recordings were found to be less than the permitted range.
Tg Actual operating temperature AOR on day d (°C)	**Line C:** **TE-104C** Range: 0-1300 °C	**Min.: 910 °C** **Max.: 919 °C** Historical: 910-925°C	The temperature in the ammonia reactor is monitored by three thermocouples delivered by Duplex Thermocouple and delivered by Thermo-electra model K-Type. The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest calibration was conducted 13 January 2008. (Calibration Procedure: INS-WI QMS-028) The range is appropriate. Accuracy: ± 2 °C All daily recordings were found to be within the permitted range.
Pg Actual operating pressure AOR on day d (kg/cm²)	**Line C:** **PG-AOR-Line C** Range: 0-25 kg/cm²	**Min.: 6.8** **Max.: 7.4** Historical: 6.45-7.90 kg/cm²	The pressure recorded for operational ammonia oxidation pressure is measured in the primary air supply line by the pressure gage. (Manufacture: Nuova Fima) The QA is covered by the Quality Management procedures of the nitric acid plant. Calibration every 1 year. The latest

			calibration was conducted 14 January 2008. (Calibration Procedure: INS-WI QMS-021) The range is appropriate. Accuracy: ± 2% of span All daily recordings were found to be within the permitted range.
Gsup Supplier of the ammonia oxidation catalyst	-	**Johnson Matthey** Historical: Johnson Matthey	The purchase document and shipping document were made available to verify the supplier /13/.
Gcom Composition of the ammonia oxidation catalyst	-	**90% Pt , 10% Rh** Historical: 90% Pt, 10% Rh	The purchase document and shipping document were made available to verify the composition /13/. Normal campaign length is 1000 hrs (41.7 days).
P_HNO_3 Plant output of nitric acid $tHNO_3$	**Line C:** Flow meter: **FQ-07 309C** Transmitter: **FT-02306C** Range: 0-15 m^3/h	**17 326** $tHNO_3$ Average daily production is 142.0 Design Capacity: 180 $tHNO_3$/day	The nitric acid flow is measured with a Vortex magnetic flow meter supplied by Krohne (IFC-090). Accuracy: ± 2% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 year. The latest calibration was conducted 18 January 2008 for the flow meter and 27 August 2007 for the temperature transmitter. (Calibration Procedure: Ref. 05-25) /12/. 100% nitric acid in tons is determined from the volume flow rate, density, concentration and temperature of the nitric acid (as described above). The hourly rate in m^3/h is automatically calculated by AMS. The nitric acid in tons is automatically adjusted from density/temperature of the acid by means of built-in adjustor. The production quantity during the period is below the design capacity of 21 960 $tHNO_3$ (for this monitoring period).

3.4.2 Monitored data for project emissions within the project boundary

The main emission source from the project is the remaining quantity of N_2O in the outlet of the De-N_2O System. The other sources are the emissions from the hydrocarbon used as a reheating agent to enhance the efficiency of the catalytic reduction, emission due to ammonia consumption by the newly installed De-NO_X System and power consumed by the De-N_2O System. Natural gas is used as the reheating fuel in Line A and B.

The equations available in AM0028 version 1 for determination of leakage related to the net change in heating of the tail gas is not directly applicable to the project activity since natural gas is used for the heating. In accordance with the monitoring plan approved on 3 December 2007, the natural gas is used within the project boundary is monitored and the emissions from natural gas are accounted for as project emissions.

The following data has been assessed in detail:

Line A:

Data variable	**Tag. No.**	**Reported value for the project period**	**Assessment/Observation**
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line A:** **FIT-1002** Range: 0- 100 000Nm^3/h	**205 885 690** Nm^3	The stack gas flow is measured with a Pitot Tube Type flow meter supplied by ABB. Accuracy: ± 0.5% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 3 months. The latest calibration was conducted 9 April 2008. No deviation over the tolerance was observed. The calibration planned in July was postponed to August 2008 due to the annual shutdown. (Calibration Procedure: INS-WI QMS-026) /12/ The hourly rate in m^3/h is automatically adjusted to standard temperature and pressure. The reported value was verified to be correct. The normal stack gas flow is 77 800 Nm^3/hr, hence the measurement range is appropriate. This normal stack gas flow corresponds to 222 196 800 for this monitoring period hence the reported flow is within the expected range.

CO_N_2O N_2O concentration at destruction facility outlet (tN_2O/Nm^3)	**Line A: AI-1003** Range: 0-500 ppmv	**3,463E-07** tN_2O/Nm^3	The N_2O concentration at destruction facility outlet is measured with a NDIR URAS 14 analyser supplied by ABB up to 3 September 2007. The project participants then replaced the NDIR with a new NDIR URAS 26. It was justified that the reason of replacement was to use consistent model with Line B for easier maintenance preparedness. Uras 26 is succeeding model of Uras 14 and Uras 14 is no longer available (there are no major technical changes in the analyser). Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month by means of built-in calibrator. The latest calibration was conducted on 14 April, 19 May (+2.5%), 16 June (+3.4%) and 16 July (+3.1%) 2008. The deviation was found at the periodic calibration as shown in the above parenthetic. The PP did not make adjustment and it is reasonable as "larger outlet N_2O concentration reading" means less CER. /12/. The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of a standard test gas were available for verification. /10/ Both readings were always consistent.
Q_ NH_3 Ammonia input to SCR De-NOx facility (NH_3 t/y)	**Line A: FIT-1001** Range: 0-105 kg/hr	**15,898** t NH_3	Monitored by Vortex Flow Meter. No maintenance or calibration needed. The monitoring range covers the actual flow rate (25 kg/hr average). The accuracy is given to be less than ± 1% of the rate at reference conditions (at 99.5% ammonia, maximum flow rate of 105 kg/hr) /23/.

Q_HCy Hydrocarbon input for tail gas reheating (Nm^3/y)	**Line A:** **FIT-1611** Range: 0-200 Nm^3/hr	**205 247,198** Nm^3	Monitored by Vortex Flow Meter. No maintenance or calibration needed. The monitoring range covers the actual flow rate. (71 Nm^3/hr average). The accuracy is given to be less than ± 1% of the rate at reference conditions (maximum 200 Nm^3/hr) /23/.

Line B:

Data variable	Tag. No.	Reported value for the project period	Assessment/Observation
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line B:** **FIT-2002** Range: 0- 100 000Nm^3/h	**214 520 422** Nm^3	The stack gas flow is measured with a Pitot Tube Type flow meter supplied by ABB. Accuracy: ± 0.5% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 3 months. The latest calibration was conducted 2 June 2008. No deviation over the tolerance was observed. The calibration planned in April was postponed to June 2008 due to the plant shutdown. (Calibration Procedure: INS-WI QMS-026) /12/ The hourly rate in m^3/h is automatically adjusted to standard temperature and pressure. The reported value was verified to be correct. The normal stack gas flow is 77 800 Nm^3/hr, hence the measurement range is appropriate. This normal stack gas flow corresponds to 220 329 800 for this monitoring period hence the reported flow is within the expected range.
CO_N2O N_2O concentration at destruction facility outlet (tN_2O/Nm^3)	**Line B:** **AI-2003** Range: 0-500 ppmv	**3,440E-07** $tN_2O/m3$	The N_2O concentration at destruction facility outlet is measured with a NDIR URAS 26. Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month. The latest calibration was conducted on 16 April, 20 May, 19 June (-13.3%), 16 July 2008. /12/ The deviation over the tolerance was detected at the planned calibration. The discount of the CER was requested. (CAR 1) The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of

			NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of a standard test gas were available for verification. /10/
Q_NH_3 Ammonia input to SCR De-NOx facility NH_3 t/y	**Line B:** **FIT-2001** Range: 0-80 kg/hr	**71,497** t NH_3	Monitored by Vortex Flow Meter. No maintenance or calibration needed. The monitoring range covers the actual flow rate. (16 kg/hr average) The accuracy is given to be less than ± 1% of the rate at reference conditions (at 99.5% ammonia, maximum flow rate of 80 kg/hr) /23/.
Q_HCy Hydrocarbon input for tail gas reheating Nm^3/y	**Line B:** **FIT-2611** Range: 0-190 Nm^3/hr	**260 914,159** Nm^3	Monitored by Vortex Flow Meter. No maintenance or calibration needed. The monitoring range covers the actual flow rate. (92 Nm^3/hr average). The accuracy is given to be less than ± 1% of the rate at reference conditions. (maximum 190 Nm^3/hr) /23/.

Line C:

Data variable	Tag. No.	Reported value for the project period	Assessment/Observation
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line C:** **FIT-3002** Range: 0- 100 000Nm^3/h	**55 560 405** Nm3	The stack gas flow is measured with a Pitot Tube Type flow meter supplied by ABB. Accuracy: ± 0.5% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 3 months. The latest calibration was conducted 27 May 2008. No deviation over the tolerance was observed. (Calibration Procedure: INS-WI QMS-026) /12/ The hourly rate in m^3/h is automatically adjusted to standard temperature and pressure. The reported value was verified to be correct. The normal stack gas flow is 28 000 Nm^3/hr, hence the measurement range is appropriate. This normal stack gas flow corresponds to 76 608 000 Nm^3 for this monitoring period hence the reported flow is within the expected range.
CO_N2O N_2O concentration at destruction facility outlet (tN_2O/Nm^3)	**Line C:** **AI-3003** Range: 0-500 ppmv	**7,330E-08** tN_2O/Nm3	The N_2O concentration at destruction facility inlet is measured with a NDIR URAS 26. Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month. The latest calibration was conducted on 4 April, 26 May, 25 June and 24 July (-2.1%) 2008. /12/ The deviation over the tolerance was detected at the planned calibration. The discount of the CER was requested. (CAR 1) The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of

			a standard test gas were available for verification. /10/ Due to the higher temperature and higher pressure the, De-N_2O efficiency is supposed to be higher than Line A/B.
Q_NH_3 Ammonia input to SCR De-NOx facility NH_3 t/y	**Line C:** **FIT-3001** Range: 0-30 kg/hr	**35,967** t NH_3	Monitored by Vortex Flow Meter. No maintenance or calibration needed. The monitoring range covers the actual flow rate (22 kg/hr average). The accuracy is given to be less than ± 1% of the rate at reference conditions (at 99.5% ammonia, maximum flow rate of 30 kg/hr) /23/.
Q_HCy Hydrocarbon input for tail gas reheating Nm^3/y	**Line C:** **N/A**	**N/A**	As De-N_2O unit of Line C is located between NH_3-SCR Unit and Pressure Recovery Turbine, hydrocarbon is not needed for re-heating the tail gas.

3.4.3 Monitored data for baseline emissions within the project boundary

The only emission source in the baseline is the inlet quantity of N_2O in the tail gas entering the De-N_2O System. The quantity of N_2O is determined from the concentration of N_2O and the volume tail gas flow. As there are no regulations on N_2O emissions in Pakistan the monitored N_2O quantity is thus the baseline emission. The following data reported in the monitoring report has been assessed in detail.

Line A:

Data variable	Tag. No.	Reported value for the project period	Assessment/Observation
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line A:** **FIT-1002** Range: 0- 100 000Nm^3/h	**205 885 690** Nm^3	Same as described above in 3.4.2.
CI_N_2O N_2O concentration at destruction facility inlet (tN_2O/Nm^3)	**Line A:** **AI-1002** Range: 0-3000 ppmv	**2,659E-06** tN_2O/m^3	The N_2O concentration at destruction facility inlet is measured with a NDIR URAS 14 analyser supplied by ABB up to 3 September 2007. The project participants then replaced the NDIR with a new NDIR URAS 26. It was justified that the reason of replacement was to use consistent model with Line B for easier maintenance

			preparedness. Uras 26 is succeeding model of Uras 14 and Uras 14 is no longer available (there are no major technical changes in the analyser). Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month by means of built-in calibrator. The latest calibration was conducted on 14 April, 19 May (-4.6%), 16 June (-1.3%) and 16 July 2008. /12/ The deviation over the tolerance was detected at the planned calibration. However it caused less CER then the adjustment was not requested. The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of a standard test gas were available for verification. /10/

Line B:

Data variable	**Tag. No.**	**Reported value for the project period**	**Assessment/Observation**
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line B:** **FIT-2002** Range: 0- 100 000Nm^3/h	**214 520 422** Nm^3	Same as described above in 2.3.2
CI_N_2O N_2O concentration at destruction facility inlet (tN_2O/Nm^3)	**Line B:** **AI-2002** Range: 0-3000 ppmv	**2,981E-06** tN_2O/m^3	The N_2O concentration at destruction facility inlet is measured with a NDIR URAS 26. Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month. The latest calibration was conducted on 16 April, 20 May, 14 June (-4.5%), 16 July

			2008. /12/ The deviation over the tolerance was detected at the planned calibration. However it caused less CER then the adjustment was not requested. The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of a standard test gas were available for verification. /10/

Line C

Data variable	**Tag. No.**	**Reported value for the project period**	**Assessment/Observation**
F_TG Volume flow of tail gas from N_2O destruction unit at interval, i (Nm^3/h)	**Line C: FIT-3002** Range: 0- 100 000Nm^3/h	**55 560 405** Nm^3	Same as described above in 2.3.2
CI_N2O N_2O concentration at destruction facility inlet (tN_2O/Nm^3)	**Line C: AI-3002** Range: 0-3000 ppmv	**4,190E-06** tN_2O/m^3	The N_2O concentration at destruction facility inlet is measured with a NDIR URAS 26. Accuracy: ± 1.0% of span The QA is covered by the Quality Management procedures of the Nitric acid plant. Calibration is done every 1 month. The latest calibration was conducted on 4 April 2008, 26 May, 25 June and 24 July (-12.9%) 2008. /12/ The deviation over the tolerance was detected at the planned calibration. However it caused less CER then the adjustment was not requested. The NDIR is cross-checked weekly by sampling and analysing by gas chromatography (GC) and the results were compared with the instantaneous reading of NDIR. The results were consistent between them. /22/ GC is calibrated prior to use with standard test gas and the certificates of a standard test gas were available for verification. /10/

3.4.4 Other factors and calculated parameters

The following parameters are used in the calculation of emissions reductions or are parameters needed to be reported in relation to regulation of N_2O emissions. The verification team has manually checked the calculated values by use of raw data. For other data as required by AM0028 the source of data is checked.

Line A:

Data variable	Reported value for the verification period	Checks/Assessment/ Observation
EF_ NH_3 CO_2 emission factor of ammonia production $tCO_2/tNH3$	**Line A: 2.14**	The default value for ammonia production was applied. (GEMIS 4.2)
PE_NH_3 Project emission related to ammonia input to destruction facility tCO_2	**Line A: 34,091**	**= EF_NH_3 * Q_NH_3**
C_HNCy Methane content on hydrocarbon %	**Line A: 88.47**	Supplier's certificate of analysis. This value was determined based on the annual average methane content of the previous year (2007). It was verified to be correct through the analytical data. /19/
Q_HNCy Methane input for tail gas reheating Nm^3/y	**Line A: 181 582.196**	= Q_HCy * C_NHCy
HCE_NCy Non-converted hydrocarbon emission tCO_2	**Line A: 13,613**	= ρ_HNCy *Q_HNCy*(1-OXID_CH_4)* GWP_CH_4 ρ_HNCy: 0.000714 t/m^3 OXID_CH_4: 99.5% GWP_CH_4: 21 tCO_2/tCH_4
EF_HC Hydrocarbon CO_2 emission factor tCO_2e/t	**Line A: 2.75**	IPCC default value for natural gas was applied.
ρ_HC Hydrocarbon density (content) t/Nm^3	**Line A: 6.43E-04**	Supplier's certificate of analysis specifies 90.00% C1 (methane) to C3 (propane). Others were N_2 and CO_2. The hydrocarbon density at standard conditions of 6.43E-04 t/Nm^3 (CH_4 density*90%).

HCE_C Converted hydrocarbon emissions tCO_2e	**Line A: 361.114**	The conversion factor of 99.5% for both hydrocarbon (C2+) and methane was applied. The spread sheet calculations are checked and found to be correct.
PE_ND Project emissions from N_2O not destroyed (tCO_2e)	**Line A: 22 099.280**	These parameters are calculated from the N_2O concentration monitored in the outlet of the destruction unit, the tail gas flow, and the GWP_{N2O} of 310. The calculations are checked and found to be correct
BEy Baseline emissions in year y (tCO_2e)	**Line A: 169 677.880**	The baseline emissions are calculated from the N_2O concentration monitored in the tail gas inlet to the destruction unit, the tail gas flow, and the GWP_{N2O} of 310. The calculations are checked by the spreadsheet.
SE_N_2O Specific N_2O emissions per ton HNO3 ($tN_2O/tHNO_3$)	**Line A: 8.189E-3**	The levels of baseline emissions were calculated based on the values monitored at inlet of De-N_2O facility. The calculations are checked and found to be correct.
RSE_N_2O,y National Regulatory limit of N_2O emissions per output nitric acid (t N_2O /$tHNO_3$)	No regulation	No national emission regulation of N_2O in Pakistan.
CR_N_2O Regulatory limit for specific N_2O concentration during interval I (t N_2O/m^3)	No regulation	No national emission regulation of N_2O in Pakistan.
Reg_NOx National regulation on NO_X emissions mg NO_X/m^3	3000	The limits of NO_X emission from Nitric acid plants to 3000 mg NO_X/ m^3.

Line B:

Data variable	**Reported value for the verification period**	**Checks/Assessment/ Observation**

EF_ NH_3 CO_2 emission factor of ammonia production (tCO_2/tNH_3)	**Line B: 2.14**	The default value for ammonia production was applied. (GEMIS 4.2)
P_NH_3 Project emission related to ammonia input to destruction facility (tCO_2)	**Line B: 153.309**	**= EF_NH_3 * Q_NH_3**
C_NHCy Methane content on hydrocarbon (%)	**Line B: 88.47**	Supplier's certificate of analysis. This value was determined based on the annual average methane content of the previous year (2007). It was verified to be correct through the analytical data. /19/
Q_HNCy Methane input for tail gas reheating Nm^3	**Line B: 230 830.760**	= Q_HCy * C_NHCy
HCE_NCy Non-converted hydrocarbon emission tCO_2	**Line B: 17.305**	= ρ_HNCy *Q_HNCy*(1-OXID_CH_4)* GWP_CH_4 ρ_HNCy: 0.000714 t/m³ OXID_CH_4: 99.5% GWP_CH_4: 21 tCO_2/tCH_4
EF_HC Hydrocarbon CO_2 emission factor tCO_2e/t	**Line B: 2.75**	IPCC default value for natural gas was applied.
ρ_HC Hydrocarbon density (content) t/Nm^3	**Line B: 6.43E-04**	Supplier's certificate of analysis specifies 90.00% C1 (methane) to C3 (propane). Others were N_2 and CO_2. The hydrocarbon density at standard conditions of 6.43E-04 t/Nm³ (CH_4 density*90%).
HCE_C Converted hydrocarbon emissions tCO_2e	**Line B: 459.054**	The conversion factor of 99.5% for both hydrocarbon (C2+) and methane was applied. The spread sheet calculations are checked and found to be correct.
PE_ND Project emissions from N_2O not destroyed (tCO_2e)	**Line B: 22 805.070**	These parameters are calculated from the N_2O concentration monitored in the outlet of the destruction unit, the tail gas flow, and the GWP_{N2O} of 310. The periodic calibration conducted on 19 June revealed the analyser reading was deviated over the tolerance of ±1%. It is deemed that the analyser reading had been deviated from the next

		date of the previous calibration, 21 May to 19 June 2008. CAR 1 was raised to correct the value and it was corrected. The calculations and the rationale of correction are checked and found to be appropriate
BEy Baseline emissions in year y (tCO_2e)	**Line B: 198 258.346**	The baseline emissions are calculated from the N_2O concentration monitored in the tail gas inlet to the destruction unit, the tail gas flow, and the $GWPN_2O$ of 310.
SE_N_2O Specific N_2O emissions per ton HNO_3 ($tN_2O/tHNO3$)	**Line B: 9.465E-3**	The levels of baseline emissions were calculated based on the values monitored at inlet of De-N_2O facility. The calculations are checked and found to be correct.
RSE_N_2O,y National Regulatory limit of N_2O emissions per output nitric acid (t N_2O /$tHNO_3$)	No regulation	No national emission regulation of N_2O in Pakistan.
CR_N_2O Regulatory limit for specific N_2O concentration during interval I (t N_2O/m^3)	No regulation	No national emission regulation of N_2O in Pakistan.
Reg_NOx National regulation on NOx emissions mg NO_X/m^3	3000	The limits of NO_X emission from Nitric acid plants to 3000 mg NO_X/ m^3.

Line C:

Data variable	**Reported value for the verification period**	**Checks/Assessment/ Observation**
EF_ NH_3 CO_2 emission factor of ammonia production (tCO_2/tNH_3)	**Line C: 2.14**	The default value for ammonia production was applied. (GEMIS 4.2)

P_NH_3 Project emission related to ammonia input to destruction facility (tCO_2)	**Line C: 77.124**	**= EF_NH_3 * Q_NH_3**
C_NHCy Methane content on hydrocarbon (%)	**Line C: N/A**	Hydrocarbon is not used for reheating the tail gas at Line C.
Q_HNCy Methane input for tail gas reheating Nm^3/y	**Line C: N/A**	-ditto-
HCE_NCy Non-converted hydrocarbon emission tCO_2	**Line C: N/A**	-ditto-
EF_HC Hydrocarbon CO_2 emission factor tCO_2e/t	**Line C: N/A**	-ditto-
ρ_HC Hydrocarbon density (content) t/Nm^3	**Line C: N/A**	-ditto-
HCE_C Converted hydrocarbon emissions tCO_2e	**Line C: N/A**	-ditto-
PE_ND Project emissions from N_2O not destroyed (tCO_2e)	**Line C: 1262.436**	These parameters are calculated from the N_2O concentration monitored in the outlet of the destruction unit, the tail gas flow, and the GWP_{N2O} of 310. The periodic calibration conducted on 24 July revealed the analyser reading was deviated over the tolerance of ±1%. It is deemed that the analyser reading had been deviated from the next date of the previous calibration, 26 June to 24 July 2008. CAR 1 was raised to correct the value and it was corrected. The calculations and the rationale of correction are checked and found to be appropriate

BEy Baseline emissions in year y (tCO_2e)	**Line C: 72 163.350**	The baseline emissions are calculated from the N_2O concentration monitored in the tail gas inlet to the destruction unit, the tail gas flow, and the $GWPN_2O$ of 310.
SE_N_2O Specific N_2O emissions per ton HNO_3 ($tN_2O/tHNO_3$)	**Line C: 1.344E-2**	The levels of baseline emissions were calculated based on the values monitored at inlet of De-N_2O facility. The calculations are checked and found to be correct.
RSE_N_2O,y National Regulatory limit of N_2O emissions per output nitric acid (t N_2O /tHNO_3)	No regulation	No national emission regulation of N_2O in Pakistan.
CR_N_2O Regulatory limit for specific N_2O concentration during interval I (t N_2O/m^3)	No regulation	No national emission regulation of N_2O in Pakistan.
Reg_NO_X National regulation on NO_X emissions mg NO_X /m³	3000	The limits of NO_X emission from Nitric acid plants to 3000 mg NO_X / m³.

3.4.5 Emissions outside the project boundary and leakages

The emissions due to power consumption by the De-N_2O facility are not required to be monitored by the applied methodology. However, this has to be monitored in accordance with the registered PDD and also the revised monitoring plan as leakage approved on 3 December 2007

EI_RCSy Electric power consumption by De-N_2O Facility MWh	**Line A: 61.447** **Line B: 70.828** **Line C: 34.583**	Cumulative value of power meter reading.
EF_RCS Carbon emission factor of power consumed tCO_2/MWh	**Line A/B/C: 1.2598**	The carbon emission factor was calculated from the data obtained from the power supplier.

LE_RCSy Emission due to power consumption by De-N_2O facility tCO_2/y	**Line A: 77.411** **Line B: 89.229** **Line C: 43.568**	Line A= 61.447 MWh * 1.2598 tCO_2/MWh Line B= 70.828 MWh * 1.2598 tCO_2/MWh Line C= 34.583 MWh * 1.2598 tCO_2/MWh

3.5 Accuracy of Emission Reduction Calculations

There is no uncertainty related to manual transfer of data used in the calculation of emission reduction since these monitored parameters are collected by the automated measurement system.

All of the operation parameters of the ammonia oxidation reactor of Line A, B and C have been maintained within the permitted operating conditions during the period.

The calculation of the emission reduction for the monitoring period was checked by the verification team and found to be correct. However the deviations over the tolerance were observed at the periodic calibration as follows;

1) Line A: inlet of De-N_2O facility, -4.6%, 19 May
2) Line A: outlet of De-N_2O facility, +2.5%, 19 May
3) Line A: inlet of De-N_2O facility, -1.3%, 16 June
4) Line A: outlet of De-N_2O facility, +3.4%, 16 June
5) Line A: outlet of De-N_2O facility, +3.1%, 16 July
6) Line B: inlet of De-N_2O facility, -4.5%, 14 June
7) Line B: outlet of De-N_2O facility, -13.3%, 19 June
8) Line C: inlet of De-N_2O facility, -12.9%, 24 July
9) Line C: outlet of De-N_2O facility, -2.1%, 24 July

Among the above, over reading of outlet N_2O concentration and under reading of inlet N_2O concentration are supposed to conservative thus 1)-5), 6) and 8) did not need to be corrected. However under reading of outlet N_2O concentration leads less project emission and more emission reduction. Thus 7) and 9) were requested to be corrected. (CAR 1)

Spreadsheets describing these events and the corresponding re-calculations were made available for the verification team. The recalculations have been checked and found to be conservative and reasonable.

3.6 Quality of Evidence to Determine Emission Reductions

The main parameters are automatically collected by NDIR Uras26 and EMS2000 automated monitoring system provided by ABB. All necessary documentation is collected, referenced and aggregated and is easily accessible in spread sheets.

As mentioned in the previous verification report, at the time of installing the NDIR N_2O analyser for Line B, Uras 14 was no longer available, thus the project participants selected the succeeding model, Uras 26 for Line B. The NDIR N_2O analyser for Line A was also replaced with Uras 26

aiming for more practical operation, e.g. keeping common spare parts. Uras 26 is succeeding model of Uras 14, there are no major technical changes in the analyser.

The NDIR N_2O analysers have been calibrated monthly by a built-in calibrator and weekly cross-checked by sampling and analysing using gas chromatography (GC). The GC is calibrated prior to use with standard test gas. The certificates of the test gas were available for verification. The other measurements are performed by calibrated equipment according to the documented calibration procedure, and the key data can also be cross-checked via other sources, such as production log sheets and meters available in the operators control room or on-site. The calibration results are traceable to the national standards through the accredited laboratory, ERA Lab. No assumptions are used that have any material influence on reported emission reductions. All actions performed at the computer station are logged and the log file is available for the verifier.

3.7 Management System and Quality Assurance

The project is operated by Pakarab Fertilizer Limited. The monitoring and reporting of data under the CDM activity have been conducted by the collaboration of Pakarab Fertilizer Limited and Mitsubishi Corporation. The quality assurance and quality control procedures in terms of equipment operation and maintenance as well as data reporting are covered by the documented procedures.

The ammonia nitrate of the Pakarab Fertilizer Limited have recently been ISO9001:2000 certified. Although the nitric acid plant and the project activity have not yet been certified, they already deployed the equivalent quality management system based on ISO9001: 2000. They have a plan to get certified in near future.

Local operators, instrumentation engineers and calibration personnel of the system have been trained by equipment suppliers and qualified internally. Data handling solutions involve redundancy, data manipulation protection, integrity check as well as proper archiving.

3.8 Corrective and Forward Action Requests identified

The below table lists the corrective and forward action requests that were identified during this verification (including the remaining FAR's from the previous periodic verifications, see chapter 3.1).

FAR / CAR	Description of the CAR/FAR	Comments/ Response from project proponent	Conclusions
CAR 1	The periodic calibration revealed deviations of the NDIR analysers. However the monitored data were not adjusted properly.	The deviations were taken into account and the calculated N_2O emissions were corrected in the revised spreadsheet. CER was discounted.	OK
FAR 1	(See CAR 1.) Although the documented procedure was established to adjust the values in case of problems of monitoring	The amendment of documented procedure and/or other counter measures should be considered to prevent the similar problems effectively.	This FAR will be checked during the next verification.

	equipment, some reported values were not adjusted properly.		
FAR 2 (Periodic verification 2)	The revised monitoring report includes the description regarding the contribution to sustainable development. However, in the PDD it is described that a portion of the revenue generated from CERs will be transferred in a Social Fund. The implementation of this Social Fund should be further described and it is required to develop monitoring procedures in order to be able to perform verification of these measures.	The template for a monitoring report was amended to include the item "11. Compensation of revenue for social benefits" to prevent misstatement.	OK
FAR 1 (Periodic Verification 1)	NH_3 consumption of 20 April 2007 was 182 t/day and exceeded the maximum historical value and the project participants did not apply the IPCC default value. Although this was corrected properly in the revised monitoring report, measures are recommended to be implemented in order to prevent similar misstatements.	The template for a monitoring report was amended to include the item "10. Monitoring against the baseline requirements" to prevent misstatement.	OK
FAR 2 (Periodic Verification 1)	Through the periodic calibration of the stack gas flow meter of Line A on 16 May 2007, the deviation of +4.72% was observed against ±0.5% variance limit. It was corrected properly. However, measures are recommended to be implemented in order to prevent similar occurrences.	The documented procedure was established to clarify the tasks of respective personnel to prevent the similar problems. However the deviations of NDIRs were not addressed properly and the counter measures are deemed ineffective. This FAR was closed and a new FAR was raised above. (FAR 1)	Closed (see FAR 1)
FAR 5 (Periodic Verification 1)	Competence and training needs are covered by QMS of Pakarab Fertilizer Ltd. Necessary competence	The follow-up trainings were provided on 19 May and 23 July 2008. The training records were kept properly. /20/	OK

	requirements for DeNOx/DeN$_2$O system operation and the monitoring practice are identified and provided by the engineering provider. The certificate of the initial training and the consecutives performance development program are recommended to be addressed.		
FAR 6 (Periodic Verification 1)	Allocation of responsibilities is clearly recognised among the project participant. It is recommended to be documented.	The documentation was verified to be appropriate. /21/	OK

4 PROJECT SCORECARD

Risk Areas		Conclusions			Summary of findings and comments	Error/Discounted Uncertainty Tonnes
		Baseline Emissions	Project Emissions	Calculated Emission Reductions		
Completeness	• Source coverage/ boundary definition	OK	OK	OK	N_2O emission regulation in Pakistan monitored was included in the monitoring report. (FAR 3_PV1 resolved) All main parameters are covered and the boundaries of the project are correctly defined. Sustainable development related issue which the project participants had committed in the registered PDD was included in the monitoring report. (FAR 2_PV2 resolved).	None
Accuracy	• Physical Measurement and Analysis	OK	OK	OK	No issue found.	None
	• Data calculations	OK	OK	OK	The deviation over the tolerance of the monitoring equipment for N_2O concentration of the outlet of de-N_2O facilities was observed. However the data adjustment was not made properly. (CAR 1_PV4) The corrected values were verified to be appropriate as follows; - PE_{NDy}(Line B): 22 804.771 tCO_2 (increase 797.191 tCO_2)	-804 tCO_2

Risk Areas		Conclusions			Summary of findings and comments	Error/Discounted Uncertainty Tonnes
		Baseline Emissions	Project Emissions	Calculated Emission Reductions		
					- PE_{NDy}(Line C): 1 262.436 tCO_2 (increase 6.936 tCO_2) Carbon emission factor of electricity used for calculating $EI_{RCS,y}$ of Line C by the spreadsheet was requested to be corrected. It was corrected properly however no impact on the reported emission reduction. (CAR 1_PV3 resolved)	
	• Data management & reporting	OK	OK	OK	It was experienced at 1st periodic verification that the excess NH_3 consumption and the deviation of stack gas monitoring had been overlooked. Then the participants were recommended to establish the procedure to avoid misstatement. (FAR 1/2_PV1 resolved)	None
Consistency	• Changes in the project	OK	OK	OK	There are no changes in the project.	None

5 CERTIFICATION STATEMENT

Introduction

Det Norske Veritas Certification AS (DNV) has been engaged by Mitsubishi Corporation to verify the greenhouse gas (GHG) emission reductions reported for the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan" for the period 1 April 2008 to 31 July 2008.

Responsibilities of the management of the project and DNV

The management of the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan" is responsible for the preparation of the GHG emissions data and the reported GHG emissions reductions on the basis set out within the project's monitoring plan and as reported in the revised monitoring report dated 22 August 2008. The development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of GHG emission reductions from the project, is the responsibility of the management of the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan".

It is DNV's responsibility to express an independent GHG verification opinion on the GHG emission reductions reported for the project for the period 1 April 2008 to 31 July 2008 and the project's compliance with the approved methodology AM0028, version 1, and the revised monitoring plan approved on 3 December 2007. Our opinion relates to the project's GHG emissions and resulting GHG emissions reductions reported in the monitoring report dated 22 August 2008. We express no opinion on the baseline determination of the project or on the validated Project Design Document.

Basis of GHG verification opinion

Our approach is risk-based, drawing on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these. Our examination includes assessment, on a test basis, of evidence relevant to the information in relation to the project's GHG emission reductions for the period 1 April 2008 to 31 July 2008.

We planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that the amount of calculated GHG emission reductions for 1 April 2008 to 31 July 2008 are fairly stated.

We conducted our verification on the basis of the monitoring methodology AM0028, version 1, and the revised monitoring plan approved on 3 December 2007.

The verification included:

- Collection of evidence supporting the reported data
- Checking whether the provisions of the monitoring methodology AM0028, version 1, and the monitoring plan revised by the project participants and accepted by EB36 were consistently and appropriately applied

We have verified whether the information included in the monitoring report dated 22 August 2008 is correct and that the emissions reduction achieved has been determined correctly.

Certification Statement

In our opinion, the GHG emission reductions stated in the monitoring report of 22 August 2008 for the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan" for the period from 1 April 2008 to 31 July 2008 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology AM0028 version 1 and the revised monitoring plan approved on 3 December 2007.

Hence, Det Norske Veritas Certification AS is able to certify that the emission reductions from the "Catalytic N_2O Abatement Project in the Tail Gas of the Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan" during the period from 1 April 2008 to 31 July 2008 amount to 392 606 (three hundred ninety two thousand six hundred and six) tonnes of CO_2 equivalents.

Yokohama, 8 October 2008

Akira Sekine

CDM Verifier

Oslo, 8 October 2008

Michael Lehmann

Technical Director

6 REFERENCES

Documents provided by the project participants that relate directly to the project:

/1/ Monitoring Report: Catalytic N_2O Abatement Project in the Tail Gas of Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan No. 4 version 00, 8 August 2008

Monitoring Report: Catalytic N_2O Abatement Project in the Tail Gas of Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan No. 4 version 01, 22 August 2008

/2/ CDM Project Design Document: "Catalytic N_2O Abatement Project in the Tail Gas of Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan, 6 August 2006

/3/ CDM Project Spreadsheet for the verification period 1 April 2008 to 31 July 2008:

- Operating data from SCR-DeNO_X /DeN_2O System installations
- Summary sheet of emission reduction calculations
- Operating data and permitted ranges for ammonia oxidation reactors

/4/ Daily monitoring reports, generated by EMS2000 system.

Background documents related to the design and/or methodologies employed in the design or other reference documents:

/5/ Approved Monitoring methodology AM0028, version 01 of March 03, 2006.

/6/ International Emission Trading Association (IETA) & the World Bank's Prototype Carbon Fund (PCF): *Validation and Verification Manual*. http://www.vvmanual.info

/7/ Validation report TÜV SUD: "Catalytic N_2O Abatement Project in the Tail Gas of Nitric Acid Plants of the Pakarab Fertilizer Ltd (PVT) in Multan, Pakistan; REPORT NO. 829330, 7 August 2006.

/8/ Equipment lists and specifications for monitoring equipment and analysers of Regenerative Catalytic DeN_2O systems.

/9/ Product Conformity Certificate: EN14181/EN ISO14956, TÜV-SÜD, 30 June 2006

/10/ Certificates of analysis of N_2O calibration test gases, BOC Pakistan Limited

- Lot. 84-1782 (High Range), 28 October 2006
- Lot. 83-2453 (High Range), 28 October 2006
- Lot. 419698 (Low Range), 28 October 2006
- Lot. 87210 (Low Range), 28 October 2006

Certificates of analysis of N_2O calibration test gases, Air Products and Chemicals Inc.

- Lot. 300024 (High Range), 13 December 2007
- Lot. 300020 (Low Range), 13 December 2007

Certificates of analysis of NO_2 calibration test gases, Air Products and Chemicals Inc.

- Lot. 300100, 13 December 2007
- Lot. 300090, 31 December 2007

/11/ Certificate of calibration, Pitot Tube Flow Meter, ABB, No. 07/05486, 29 May 2007

/12/ Calibration reports (Line A):

- Outlet NO_X Analyser (AI-1001), 14 April, 19 May, 16 June, 16 July 2008
- Stack Gas Flow Meter (FIT-1002), 9 April 2008
- Inlet N_2O Analyser (AI-1002), 14 April, 19 May, 16 June, 16 July 2008
- Outlet N_2O Analyser (AI-1003), 14 April, 19 May, 16 June, 16 July 2008
- Nitric Acid Flow Meter (FT-02360A), 20 January 2008
- AOR Temperature (TE-02104A), 9 January 2008
- AOR Pressure (PG-AOR-Line A), 12 January 2008
- AOR Ammonia Consumption (FT-02301A), 10 January 2008
- SCR $DeNO_X$ Ammonia Flow Meter (FIT-1001), 10 October 2006
- Reheating Fuel Gas Flow Meter (FIT-1611), 10 October 2006
- Temperature in nitric acid line (TE-02102-15A), 16 September 2007

Calibration reports(Line B):

- Outlet NO_X Analyser (AI-2001), 16 April, 20 May, 19 June, 16 July 2008
- Stack Gas Flow Meter (FIT-2002), 2 June 2008
- Inlet N_2O Analyser (AI-2002), 16 April, 20 May, 19 June, 16 July 2008
- Outlet N_2O Analyser (AI-2003), 16 April, 20 May, 19 June, 16 July 2008
- Nitric Acid Flow Meter (FT-02360B), 18 January 2008
- AOR Temperature (TE-02104B), 10 January 2008
- AOR Pressure (PG-AOR-Line B), 14 January 2008
- AOR Ammonia Consumption (FT-02301B), 23 January 2008
- SCR $DeNO_X$ Ammonia Flow Meter (FIT-2001), 10 October 2007
- Reheating Fuel Gas Flow Meter (FIT-2611), 10 October 2007
- Temperature in nitric acid line (TE-02102-15B), 16 September 2007

Calibration reports(Line C):

- Outlet NO_X Analyser (AI-3001), 4 April, 26 may, 25 June and 24 July 2008
- Stack Gas Flow Meter (FIT-3002), 27 May 2008
- Inlet N_2O Analyser (AI-3002), 4 April, 26 May, 25 June, 24 July 2008
- Outlet N_2O Analyser (AI-3003), 4 April, 26 May, 25 June, 24 July 2008

- Nitric Acid Flow Meter (FT-02360C), 18 January 2008
- AOR Temperature (TE-02104C), 13 January 2008
- AOR Pressure (PG-AOR-Line C), 14 January 2008
- AOR Ammonia Consumption (FT-02301C), 11 January 2008
- SCR DeNO$_X$ Ammonia Flow Meter (FIT-3001), 10 November 2007
- Temperature in nitric acid line (07 TE-1-13), 27 August 2007

/13/ Johnson Matthey Noble Metals, Ammonia Oxidation Catalyst Shipping Document, 6 February 2008, 29 February 2008

Johnson Matthey Noble Metals, Acknowledgement of Order, 19 December 2007

/14/ Inspection Report incl. calibration and linearity test results: N_2O Concentration Meter, Uras26, ABB K.K.,

- Line A: Order No. 04702370 3.345936.7, issued on 15 May 2007
- Line B: Order No. 04702332 3.345937.7, issued on 18 May 2007
- Line C: Order No. 04702332 3.345938.7, issued on 18 May 2007

/15/ Calculation Report and Dimensional Drawing: Averaging Pitot Tube, Model 412, Ref. TE-20637212-001, 8 September 2006

/16/ Data Logging System Specifications: D-MS500KE and D-EMS2000, Ref. 61566020, ABB K.K., 8 November 2006

/17/ Statutory Notification, National Environmental Quality Standards for Industrial Gaseous Emission, The Gazette of Pakistan, 10 August 2000

/18/ Revised monitoring plan for the project approved on 3 December 2007

/19/ PFL Laboratory, Natural Gas Analysis Report, January – December 2007

/20/ Training record, 19 May 2008

Training record, 23 July 2008

/21/ Documentation defining the responsibility and authority of the CDM team, “Organogram”, 14 May 2008

/22/ PFL Laboratory, N_2O analysis results by GC (April – July 2008)

/23/ ABB, Data Sheet of Vortex Flow Meter (FV4000-VT4/VR4)

/24/ Nitric Acid Concentration Conversion Diagram (HNO_3 Konzentrationen D18533-16)

/25/ Nitric Acid Production Data

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APPENDIX A

VERIFICATION CHECKLIST

Table 1: Data Management System/Controls

The project operator's data management system/controls are assessed to identify reporting risks and to assess the data management system's/control's ability to mitigate reporting risks.

The GHG data management system/controls are assessed against the expectations detailed in the table. A score is assigned as follows:

- Full - all best-practice expectations are implemented.
- Partial - a proportion of the best practice expectations is implemented
- Limited - this should be given if little or none of the system component is in place.

Expectations for GHG data management system/controls	Score	Verifiers Comments (including *Forward Action Requests*)
A. Defined organisational structure, responsibilities and competencies		
A.1. Position and roles *Position and role of each person in the GHG data management process is clearly defined and implemented, from raw data generation to submission of the final data. Accountability of senior management must also be demonstrated.*	Full	A reporting process organisation chart (CDM Unit) including named personnel was presented. It was well understood by the personnel and senior accountability was appropriate.
A.2. Responsibilities *Specific monitoring and reporting tasks and responsibilities are included in job descriptions or special instructions for employees.*	~~Partial~~ ~~FAR 6 (PV1)~~ Full	Specific monitoring and reporting tasks are described in the relevant documented Pakarab Fertilizer Ltd. QMS procedures. The responsibility and authority among Pakarab Fertilizer are clearly recognised among Pakarab Fertilizer Ltd. ~~However the allocation of the responsibilities among Pakarab Fertilizer and Mitsubishi Corporation should be further clarified.~~ The documentation was modified to clarify the roles of the respective participants.

Expectations for GHG data management system/controls	Score	Verifiers Comments (including *Forward Action Requests*)
A.3. *Competencies needed* *Competencies needed for each aspect of the GHG determination process are analysed. Personnel competencies are assessed and training programme implemented as required.*	~~Partial~~ ~~FAR 5 (PV1)~~ Full	Competencies of the personnel in charge of monitoring and calculation process deem to be sufficient. ~~The certificate of the initial training and the consecutives performance development program are recommended to be addressed.~~ During the monitoring period follow-up training was provided twice. The training records were verified.
B. Conformance with monitoring plan		
B.1. Reporting procedures *Reporting procedures should reflect the monitoring plan content. Where deviations from the monitoring plan occur, the impact of this on the data is estimated and the reasons justified.*	~~Partial~~ ~~FAR 1 (PV1)~~ FAR 1 (PV4) ~~FAR 4 (PV1)~~	No material deviation from the revised monitoring plan has been found. The adjustment and/or correction sequences in case of deviation from the permitted operation conditions of the ammonia oxidation reactor and the deviation from the tolerable range of the key monitoring equipment should be addressed in the procedure. The tasks of the individual personnel are defined in the documentation to avoid the similar problems. However the similar problems recur during the 4th monitoring period. FAR 1 (PV4) was raised again. ~~Although it is not included in the monitoring plan, the sustainability indicator committed by the project participants should be described in the monitoring report.~~ "Compensation of revenue for social benefits" is included in the monitoring report describing the planned activities.
B.2. Necessary Changes *Necessary changes to the monitoring plan are identified and changes are integrated in local procedures as necessary.*	Full	There is no change occurred during the monitoring period. The revision of the monitoring plan accepted by EB36 was already integrated in the local procedures.

Expectations for GHG data management system/controls	Score	Verifiers Comments (including *Forward Action Requests*)
C. Application of GHG determination methods		
C.1. Methods used *There are documented description of the methods used to determine GHG emissions and justification for the chosen methods. If applicable, procedures for capturing emissions from non-routine or exceptional events are in place and implemented.*	~~Partial~~ ~~FAR 1 (PV1)~~ FAR 1 (PV4)	Methods used to determine GHG emissions are documented properly. However see B.1.
C.2. Information/process flow *An information/process flow diagram, describing the entire process from raw data to reported totals is developed.*	~~Partial~~ ~~FAR 3 (PV1)~~ Full	~~Although process flow is defined for the information directly relevant to the emission reduction, it was recommended to establish and maintain the procedure how to access the legal requirement. (NOx/N2O emission regulation)~~ It was confirmed that the environmental authority was responsible to notify the project participants of the regulatory change.
C.3. Data transfer *Where data is transferred between or within systems/spreadsheets, the method of transfer (automatic/manual) is highlighted - automatic links/updates are implemented where possible. All assumptions and the references to original data sources are documented.*	Full	No mistake of manual data transfer has been identified. Reference to original data sources is documented.
C.4. Data trails *Requirements for documented data trails are defined and implemented and all documentation are physically available.*	Full	All necessary raw/intermediate data is maintained properly and available for external verification.
D. Identification and maintenance of key process parameters		
D.1. Identification of key parameters *The key physical process parameters that are critical for the determination of GHG emissions (e.g. meters, sampling methods) are identified.*	Full	The key physical parameters are identified.

Expectations for GHG data management system/controls	Score	Verifiers Comments (including *Forward Action Requests*)
D.2. Calibration/maintenance *Appropriate calibration/maintenance requirements are determined.*	~~Partial~~ Full ~~FAR 7 (PV1)~~ ~~FAR 1 (PV2)~~	Calibration/maintenance requirements and procedures are determined for the key monitoring equipment. ~~The minimum maintenance requirement of Vortex Flow Meter had better be identified.~~ User manual provided by the manufacture is defined as the maintenance procedure. ~~The stack gas flow meter should be calibrated prior to the actual N_2O abatement operation.~~ The stack gas flow meter for Line C was calibrated prior to the actual N_2O abatement operation.
E. GHG Calculations		
E.1. Use of estimates and default data *Where estimates or default data are used, these are validated and periodically evaluated to ensure their ongoing appropriateness and accuracy, particularly following changes to circumstances, equipment etc. The validation and periodic evaluation of this is documented.*	~~Partial~~ ~~CAR 1~~ ~~(PV 3)~~ Partial	The default data used are properly referred. - GWP of N_2O and CH_4 - Carbon emission factor of NH3 production and natural gas combustion - Oxidation factor of CH4 and other hydrocarbons Manual data transfer errors were observed in ex ante carbon emission factor of electricity consumption. No similar problems are observed at the verification. It is to be checked at consecutive verifications.
E.2. Guidance on checks and reviews *Guidance is provided on when, where and how checks and reviews are to be carried out, and what evidence needs to be documented. This includes spot checks by a second person not performing the calculations over manual data transfers, changes in assumptions and the overall reliability of the calculation processes.*	~~Partial~~ ~~FAR 1/2 (PV1)~~ FAR 1 (PV4)	Some deviations from the monitoring procedures were observed. Checks/reviews and internal verification process should be established in order to reduce risks of misstatement. The tasks of individual personnel including such corrections were identified in the documentation. However it is ineffective considering the recurrence of the similar problems.

Expectations for GHG data management system/controls	Score	Verifiers Comments (including *Forward Action Requests*)
E.3. Internal verification *Internal verifications include the GHG data management systems, to ensure consistent application of calculation methods.*	~~Partial~~ ~~FAR 1/2 (PV1)~~ Partial	See above.
E.4. Internal validation *Data reported from internal departments should be validated visibly (by signature or electronically) by an employee who is able to assess the accuracy and completeness of the data. Supporting information on the data limitations, problems should also be included in the data trail.*	~~Partial~~ ~~FAR 2 (PV1)~~ FAR 1 (PV4)	The internal validation process is not sufficient for the verification team to confirm it. (see comments E.2.)
E.5. Data protection measures *Data protection measures for databases/spreadsheets should be in place (access restrictions and editor rights).*	Full	EMS2000 system provides for comprehensive access restriction and editor rights management. The access to EMS2000 is restricted for data security. The thermal condition of the EMS2000 is taken into consideration. The backup data are properly stored in the separate system.
E.6. IT systems *IT systems used for GHG monitoring and reporting should be tested and documented.*	Full	The automated monitoring system, EMS2000 seems to operate properly. The risk of errors is regarded low.