"N_2O abatement in HP Nitric Acid plants at Rashtriya Chemicals & Fertilizers Limited, India"

UNFCCC Ref No 2792

MONITORING REPORT

Monitoring period: 20th November 2009 - 12th February 2010
(Both days included)

Monitoring Report Version:

Version 1.0
Date: 03/06/2010

Rashtriya Chemicals and Fertilizers Limited
10th Floor, Priyadarshini,
Eastern Express Highway, Sion,
Mumbai – 400 022
Maharashtra, India
Phone: 91-22- 25523042/25523054

CONTENTS

1. Introduction:

RCF is a Public sector undertaking of Government of India. It is one of the leading producers of fertilizer in the country. The fertilizer production facility of RCF is located in Trombay near Mumbai in the state of Maharashtra. The two units are medium pressure unit at 5 – 6 Bar and High pressure unit at 7-8 bar respectively. The project activity is based in the high pressure Nitric Acid unit of the fertilizer plant of RCF.

The Purpose of this monitoring report is to calculate and clarify the GHG emission reduction quantity achieved by this project for periodic verification.

2. Reference:

- **PDD version & date:** Version 1.2; 21st July 2009
- **Methodology version:** AM0034, Version 3.2
- **Sectoral Scope:** 5
- **Type:** Chemical Industries
- **Project registration date: 20th** November 2009
- **Reference No:** 2792
- **Monitoring Period:** From 20th November 2009 to 12th February 2010
- **UNFCCC Link: http://cdm.unfccc.int/Projects/DB/DNV-CUK1248695616.14/view**
- **Crediting period (First[1])** – 20/11/2009 – 19/11/2016

This monitoring report covers the period from 20th November 2009 to 12th February 2010. The total period for this campaign is from 10th October 2009 to 12th February 2010.

3. General Description of the project activity:

This project activity is in the process of nitric acid production involves oxidation of ammonia on precious metal gauze of essentially platinum – rhodium in ammonia burner in the presence of air. This is an exothermic reaction which releases substantial heat. In the process, ammonia is oxidized to form NO, which is further oxidized to form NO_2, which is converted into Nitric Acid by absorbing NO_2 in water. N_2O is an undesirable and unavoidable by product resulted during this process which is potent GHG and do not possess any economic value.

The project activity entails installation of secondary catalyst in the ammonia reactors of one of the two nitric acid production unit of fertilizer plant of Rashtriya Chemicals and Fertilizers Limited (Hereafter referred as RCF) in India. The project activity would help in catalytic reduction of N_2O which is an undesirable by product of nitric acid production process and so emission reductions of it. N_2O is potent greenhouse gas with a very high global warming potential of 310.

4. Location of the Project Activity:

The project activity is located at Mumbai in the state of Maharashtra. The nearest airport is Santacruz in Mumbai is at a distance of 20 KM. The latitude and longitude of this project activity is $18^0$56'00" N and $72^0$51'00" E respectively.

5. Technical Description:

Nitric Acid (HNO_3) is produced through the oxidation of ammonia (NH_3) on precious metal catalyst gauze in the ammonia burner of a nitric acid plant. Nitrous Oxide (N_2O) is an undesirable by-product gas produced in the manufacture of nitric acid. Waste N_2O from nitric acid production was typically released

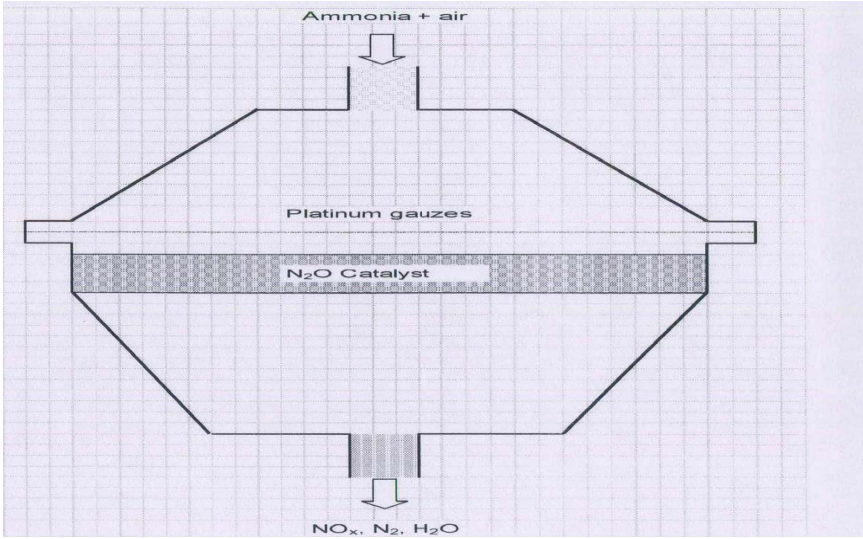
[1] Twice renewable for 7 years each

into the atmosphere as it does not have any economic value at emission levels typical of nitric acid manufacture.

RCF has installed secondary catalyst in the ammonia burner of nitric acid unit after primary catalyst, which has resulted in reduction of N_2O emission.

Technical Specifications:
In this section, details of N_2O abatement technology that includes installation of secondary catalyst in ammonia oxidation reactor are given –

RCF has purchased the catalyst from one of the reputed internationally well known catalyst suppliers M/s BASF. In presence of the catalyst N_2O is reduced to harmless N_2. The catalyst has been installed just below the primary catalyst in place of raching rings installed initially as shown below.



The technology is based on selective reduction of N_2O. The reduction is done as below in an exothermic reaction.

$$N_2O \rightarrow N_2 + ½\ O_2 \qquad \Delta H = -82\ kJ/\ mol$$

6. Monitoring Parameters:

Data / Parameter:	**NCSG**
Data unit:	mgN_2O/m^3
Description:	N_2O concentration in the stack gas
Source of data to be used:	N_2O Analyser
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	N_2O analyzer to be used for the data measurement proceeds using appropriate software. RCF have in place a Continuous Emission Monitoring (CEM) system from ABB.
QA/QC procedures to be applied:	N_2O monitor have auto calibration feature. Regular Calibrations according to ISO 9000 procedure and this analyzer was tested as per Qual2 test of recognized industry standards (EN 14181) by third party TUV Sud, Germany. Staff has been

	trained in monitoring procedures and a reliable technical support infrastructure will be set up.
Any comment:	Frequency of monitoring: Every two seconds

Data / Parameter:	**VSG**
Data unit:	Nm^3/h
Description:	Volume flow rate of the stack gas
Source of data to be used:	From CEM System
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	The data output from the stack flow meter is processed using appropriate software. RCF have in place a Continuous Emission Monitoring (CEM) System from ABB.
QA/QC procedures to be applied:	Regular Calibrations according to ISO 9000 procedure and this instrument was tested as per Qual2 test of recognized industry standards (EN14181) by third party TUV Sud, Germany.
Any comment:	Frequency of monitoring: Every two seconds.

Data / Parameter:	**OH**
Data unit:	Hours
Description:	Operating hours
Source of data to be used:	From CEM system
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Recorded at CEM System based on temperature limits of Reactor hours of daily operation of the plant during a campaign
QA/QC procedures to be applied:	Included in evaluation by third party validator.
Any comment:	In case Logic is not functioning for any period, data from log book will be taken. Frequency of recording: Hourly compiled for entire campaign

Data / Parameter:	**NAP**
Data unit:	$tHNO_3$
Description:	Nitric Acid (As 100%)
Source of data to be used:	This is a calculated data based on the following 1. Quantity of dilute nitric acid from mass flow meter. 2. Average Concentration of nitric acid determined by the plant laboratory for the day.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-

Description of measurement methods and procedures to be applied:	**Nitric Acid Flow:** Mass flow meter installed at project site and displayed on CEM system shall give hourly average flow of dilute nitric acid (from the day report of CEM system). Plant laboratory will determine the average concentration of nitric acid for the day. Hourly value shall be multiplied with average concentration to arrive at hourly nitric acid production. The sum of hourly production shall be used to calculate day production. **Nitric Acid Concentration:** Concentration will be determined by measuring specific gravity by hydrometer and temperature by thermometer. Chart indicating concentration at various temperatures and specific gravity, available with production department shall be used for determining concentration of product nitric acid.
QA/QC procedures to be applied:	**Nitric Acid Flow:** Calibration of flow meter once in three years as per OEM recommendation. **Nitric Acid Concentration:** Calibration of Hydrometer and Thermometer shall be ensured by ISO 9000
Any comment:	Frequency of recording: Hourly compiled for entire campaign. In case Mass flow meter is not functioning for any period during the day, Nitric acid Production for the day shall be calculated using Average Ammonia Specific consumption for previous three operating days and Ammonia consumption for plant for the day from meter no FI 120101. The calculated production value for the day shall be used for further processing; all other data from the Nitric acid mass flow meter for this day shall be ignored. In case concentration of nitric acid has not been determine for the day due to any reasons like shutdown, start-up etc, then: • In case of shut down data for concentration shall be taken from previous day. • In case of start-up data for concentration shall be taken from next day. • In case of shut down and start-up both data for concentration shall be taken from average of previous available day and next available day. • For any other reason not foreseen now decision from production in charge of the plant shall be taken for correctness of data based on reason of not availability. He will give decision whether previous day data to be used or next day data to be used Operation manager Nitric acid plant shall take appropriate decision for replacing the mass flow meter with similar or better instrument, if they are made available by instrument vendors in future.

Data / Parameter:	**TSG**
Data unit:	Deg C
Description:	Temperature of stack gas
Source of data to be used:	Continuous Emission Monitoring system from ABB
Value of data applied for the purpose of calculating expected	-

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Probe (part of gas volume flow meter)
QA/QC procedures to be applied:	Regular calibrations according to ISO 9000 procedure and this instrument were tested as per Qual2 test of recognized industry standards (EN 14181) by Third Party TUV Sud, Germany.
Any comment:	Frequency of monitoring: Every two seconds

Data / Parameter:	**PSG**
Data unit:	hPa
Description:	Pressure of stack gas
Source of data to be used:	Continuous Emission monitoring system from ABB
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Probe (part of gas volume flow meter)
QA/QC procedures to be applied:	Regular calibrations according to ISO 9000 procedure and this instrument were tested as per Qual2 test of recognized industry standards (EN 14181) by Third Party TUV Sud, Germany.
Any comment:	Frequency of recording: Every two seconds.

Data / Parameter:	**AFR**
Data unit:	Kg NH_3/h
Description:	Ammonia gas flow rate to AOR
Source of data to be used:	From CEM System
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	To be obtained from operating condition campaign. Ammonia flow meter is used. Transmitted from DCS.
QA/QC procedures to be applied:	Included in evaluation by third party validator
Any comment:	Frequency of monitoring: Continuous.

Data / Parameter:	**UNC**
Data unit:	%
Description:	Overall measurement uncertainty of the monitoring system
Source of data to be used:	Calculated combined uncertainty factor determined by M/s TUV Sud, during Qual2 Test of monitoring equipment as per EN14181 guide line.
Value of data applied for the purpose of	4.52

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Qual2 test by third party validator M/s. TUV Sud, Germany of Instrument as per guideline of EN14181
QA/QC procedures to be applied:	-
Any comment:	Frequency of recording: Once after monitoring system is commissioned.

Data / Parameter:	**AIFR**
Data unit:	-
Description:	Ammonia to Air ratio
Source of data to be used:	From CEM System
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Obtained from operating condition campaign transmitted from DCS
QA/QC procedures to be applied:	-
Any comment:	Frequency of recording: Every Hour.

Data / Parameter:	**OT_h**
Data unit:	Deg C
Description:	Oxidation temperature of each hour
Source of data to be used:	Continuous Emission Monitoring (CEM) system from ABB.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	Obtained from operating condition campaign transmitted from DCS
QA/QC procedures to be applied:	-
Any comment:	Frequency of monitoring: Every hour

Data / Parameter:	**OP_h**
Data unit:	kPa
Description:	Oxidation pressure of each hour
Source of data to be used:	Continuous Emission Monitoring (CEM) system from ABB.
Value of data applied for the purpose of	-

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Obtained from operating condition campaign transmitted from DCS
QA/QC procedures to be applied:	-
Any comment:	Frequency of monitoring: Every hour

Data / Parameter:	**$GS_{project}$**
Data unit:	-
Description:	Gauze Supplier for project campaign
Source of data to be used:	Plant Data
Value of data applied for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	-
Any comment:	Frequency of monitoring: Every Campaign

Data / Parameter:	**$GC_{project}$**
Data unit:	-
Description:	Gauze Composition during project campaign
Source of data to be used:	Monitored
Value of data applied for the purpose of calculating expected emission reductions in section B.5	-
Description of measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	-
Any comment:	Frequency of monitoring: Every Campaign

Data / Parameter:	**EF_{reg}**
Data unit:	
Description:	Emissions level set by incoming policies or regulations
Source of data to be used:	Monitored data
Value of data applied for the purpose of calculating expected	Zero

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	Updated when new regulations comes into force

Data Values for Monitoring Period:

Parameter	Unit	Value
VSG	Nm^3/h	49949.39
NCSG	mgN_2O/ Nm^3	890.27
OH	Hours	1928
NAP	$tHNO_3$	28812.98
TSG	Deg C	Continuously monitored
PSG	hPa	Continuously monitored
AFR	$kgNH_3/ h$	Continuously monitored
UNC	%	4.52%
AIFR	-	Obtained from DCS
OT_h	-	Continuously monitored
OP_h	-	Continuously monitored
GS project	-	Rashtriya Chemicals & Fertilizers Ltd
GC project	-	Pt - 92%, Rh - 8%
EF reg	-	0

Comparison between Ex-ante values, Full Campaign values and Verification period values:

Sr. No.	Parameter	Unit	Ex-Ante Value#	Full Campaign Value	Monitoring Period Value
1	VSG	Nm3/h	49077	50039.35	49949.39
2	NCSG	mgN2O/ Nm3	405.41	893.05	890.27
3	OH	Hours	2861	2883	1928
4	NAP	tHNO3	43326	43483.59	28812.98
5	UNC	%	4.52%	4.52%	4.52%
6	Emission Reduction	tCO2/Campaign	147059	129159	85469

As per the registered PDD.

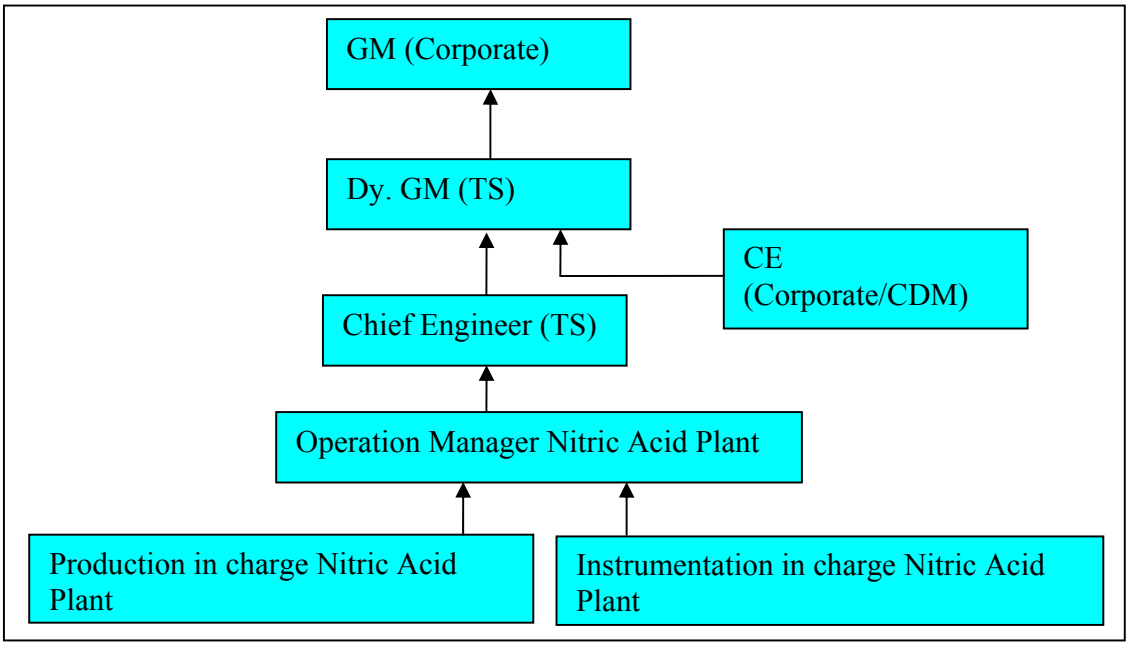
7. Description of Monitoring Methodology:

RCF is an ISO 9001 certified company and has procedure for monitoring and recording of data on operation of the plant/ equipments. The equipments/ instruments used for CDM project are also part of these procedures.

1. **CDM Team for monitoring & recording of data:**

A CDM project team is constituted with participation from relevant sections. This team is responsible for data collection and archiving. This team is periodically reviewing CDM project activity, check data collected and estimate emissions reduced. On a monthly basis, the monitoring reports is checked and discussed by the senior CDM team members. In case of any irregularity observed by any of the CDM team members, it is informed to the concerned person for necessary actions. Further these reports will then be forwarded to the management monthly basis.

Organizational structure for monitoring plan



Detailed description of responsibility of monitoring is available in CDM Manual.

1. **Data collection and record keeping:**

Frequency of data monitoring and recording
The frequency for data monitoring is as per the monitoring details in section 6 of the document.

Archiving of data
Data shall be kept for two years after the crediting period or the last issuance whichever is later

2. Quality Control and Quality Assurance

RCF has installed a monitoring system which complies with EN 14181. As per the system detailed out in the methodology AM0034, a three level quality assurance is planned. These three levels are QAL1, QAL2 and QAL3.

QAL 1 precisely ensures the suitability of the CEM to meet the requirements. CEM system has already undergone this level and a report has been availed from reputed certifying agency TUV Sud, Germany.

The monitoring system has been installed in the plant and QAL2 procedure has been carried out by M/s TUV Sud, Germany to ensure the correctness of installations

Under QAL 3, RCF is carrying out the continuous correctness of the monitoring system.

Description of the CEM installed at RCF HP Nitric Acid plant -

1. Components of CEM

RCF has installed in its HP Nitric Acid plant an Continuous Emission Monitoring (CEM) system from M/s ABB AO2000 URAS 26 comprising of Continuous Emissions Analyser (for N_2O concentration of stack gas), Sample probe, Sample Conditioning System, SDF Flow Sensor (for stack gas flow measurement).

Datalogger: Beckhoff DATA Logger
Data Acquisition System: ITBK EMI3000

2. Selection of Sample points

RCF has selected sample points for collection of samples to meet the requirements of EN 14181. The sample points have been selected as advised by the supplier ensuring its correctness,

3. Analyser System

The ABB AO2000 URAS 26 is capable of analysing N_2O concentration in gas mixtures on continuous basis. The URAS 26 is continuous NDIR industrial photometer that can selectively measure concentrations of up to four sample components. In this case it is equipped for the measurement of N_2O only. The analyzer features gas-filled opto-pneumatic detectors. Detector is filled with corresponding gas being measured. This means that the detector provides optimum sensitivity and high selectivity compared with the other gas components in the sample. Gas-filled calibration cells are used for automatic calibration. The Analyser is QAL1 tested for the measurement of N_2O.

4. Sample Conditioning System

The gas sample is extracted at the sampling point, particles are removed by the heated filter unit and the clean sample gas is delivered through a heated sampling line to the analyser cabinet. Before being fed to the analyser, moisture is removed by the sample gas cooler and sample gas feed unit installed side-by-side in the analyser cabinet. This sample gas cooler unit maintains a constant dew point of the sample gas of 3°C and efficiently separates the moisture from the sampling gas. The minimum flow rate to the analyser is controlled and connected to an alarm. The dry gas after the cooler is controlled for moisture break through. In case of moisture leaks in due to a failure of the cooler, the sampling pump will be stopped automatically and an alarm is given to the EMI3000 system.

5. Flow Meter

The SDF Flow measuring system allows continuous determination of the flow rate of stack gas. It is performance tested according to 17.BlmSchV and “TA Luft” (test report No. 936/802015, TUV Rheinland 1993) for use in plants.

The SDF flow sensor which is a flow measuring device is a highly sensitive system for continuous, in-situ flow measurement. The stack gas flow is measured in the stack by measuring the dynamic differential pressure generated by the SDF flow sensor probe rod and using ABB’s Differential pressure transmitter. Thereby the differential pressure is continuously measured and the signal is feed to Beckhoff DATA Logger and ITBK EMI3000 – CDM Data acquisition and data evaluation system.

The signal resulting from the differential pressure is proportional to the velocity of exhaust flow gas. The ABB’s Differential pressure transmitter produces a signal in proportion to the flow which is provided as 4 – 20 mA – signal to the Beckhoff DATA Logger. The stack gas pressure and temperature is also measured separately by transmitters and the corresponding 4 – 20 mA signal generated is feed to DATA Logger as input for further converting the stack flow from operating to standard conditions. This is done by EMI3000 by compensating the flow for pressure and temperature and correcting the volume flow.

6. The data acquisition system

The RCF HP nitric acid plant is equipped with a data communication unit that collects and stores all the raw values for NCSG, VSG, TSG, PSG, OT_h, OP_h, AFR, AIFR and NAP as well as different status signals from the AMS. From the data communication unit the data is transferred to the ITBK EMI3000 server grade PC in Analyser room. In the EMI3000 PC all data evaluation and storage takes place. The data is stored simultaneously on different hard disks to prevent the loss of data in case one hard disk fails.

7. Emergency preparedness

There is no plausible scenario in the project activity which can lead to emergency situation leading to unaccounted GHG emissions during the crediting period. It may be noted that in the project activity, RCF has installed a secondary catalyst and there is no change in the process. The emissions that were happening in the baseline have been reduced due to secondary catalyst.

The emissions are monitored using CEM system which complies with EN-14181 as required by the methodology in the project activity.

It is expected that all the instruments shall be functioning continuously for recording data. However following provision/methodology will be adopted during any failure of monitoring instruments.

Failure of Data Acquisition System	A Provision of auto backup of data is provided in the system so that data is retrieved even if the system is down for 22 days. In case, due to any reason data is not available due to failure of data recording following shall be considered - Data from stack meters shall be ignored while averaging and data for production has to be considered according to procedure given for failure of NAP (Nitric acid Production) measuring instrument i.e. Mass Flow Meter. However in case of failure of individual instruments following procedure shall be followed.
Failure of N_2O Analyzer (NCSG)	In case N_2O analyzer is not functioning, data for the period shall be ignored for calculating the campaign average
Failure of Stack gas Flow meter (VSG)	In case Stack gas flow meter is not functioning, hourly average of measured data for next hour shall be considered for the down period, for taking further processing.
Failure of Stack Gas Pressure (PSG)	In case Stack gas pressure meter is not functioning, Hourly average of measured data for next hour shall be considered for the down period, for taking further processing.
Failure of Stack gas Temperature (TSG)	In case Stack gas Temperature meter is not functioning, Hourly average of measured data for next hour shall be considered for the down period, for taking further processing.
Operating Hours OH	In case Operating hours meter is not functioning, Data from Shift log book shall be taken after ascertaining for how many hours the plant has run.
Failure of Mass Flow meter (NAP)	In case Mass flow meter is not functioning any time during the day, Nitric acid Production for the day shall be calculated using Average Ammonia Specific consumption for previous three operating days and Ammonia consumption for plant for the day from meter no FI 120101. The production data for the day shall be used for further processing; all other data from the Nitric acid mass flow meter for this day shall be ignored

Operating Temperature(OT)	In case operating Temperature meter is not functioning, average of measured data for previous hour and next available hours, shall be considered for the down period, for taking further processing
Operating Pressure(OP)	In case operating Pressure meter is not functioning, average of measured data for previous hour and next available hours, shall be considered for the down period, for taking further processing
Ammonia Flow (AFR)	In case Ammonia Flow meter is not functioning, Hourly average of measured data for previous hour shall be considered for the down period, for taking further processing
Ammonia to Air Ratio (AIFR)	In case Ammonia to Air Ratio meter is not functioning, Hourly average of measured data for previous hour shall be considered for the down period, for taking further processing

8. GHG Calculations:

The emission reduction is calculated by baseline emissions minus the project emissions. The following formula is adopted for calculating emission reductions generated by the project activity:

Emission Reductions:

$$\mathbf{ER = (EF_{BL} - EF_p) * NAP * GWP_{N2O}}$$

Where

ER = Emission reductions of the project for the specific Monitoring period (tCO2e)

EF_{BL} = Baseline Emission Factor ($tN_2O/tHNO_3$)

EF_P = Emission Factor used to calculate the emissions from this particular Monitoring Period (i.e the higher of $EF_{ma,\ n\ and}\ EF_n$)

NAP = Nitric Acid production for the Monitoring Period ($tHNO_3$). The Maximum Value of NAP shall not exceed the design capacity

GWP_{N2O}= Global Warming Potential for the N_2O as per IPCC default value.

Results:

Monitoring Period:

ER = (0.0125 - 0.00297) * 28812.98 * 310

= 85,489 tCO_2

Parameter	**Unit**	**Values During Monitoring Period**
NAP	$tHNO_3$	**28812.98**
EF_{BL}	$tN_2O/tHNO_3$	0.0125
EF_p	$tN_2O/tHNO_3$	0.00298
GWP_{N2O}	tCO_2/tN_2O	310
ER	**tCO_2e**	85,469

Baseline Emissions:

As per the registered PDD, the baseline emission factor is 0.0125 tCO_2e/ $tHNO_3$

Particulars	**Unit**	**Value**
Volume flow rate of stack gas	Nm^3/h	49077
N_2O concentration in stack gas - baseline	mg N_2O/ Nm^3	4054.1
Operating hours	h/campaign	2861
Baseline emissions	tN_2O/ campaign	569.22
Uncertainty UNC	%	4.52%
HNO_3 production	$tHNO_3$/ campaign	43326
N_2O emission factor - baseline	**tN_2O/ $tHNO_3$**	**0.0125**

Adjustment of baseline:
As per the methodology, baseline emission factor is to be adjusted in following cases –

If $CL_n < CL_{normal}$, recalculate EF_{BL} by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_n.

Project Campaign 1:
CL_n (43483.59 tHNO3*) is less than CL_{normal} (44435 $tHNO_3$). However, the CL_{BL} (43326 tHNO3) is even less than CL_n and hence adjustment of Baseline EF is not required.

* The CL_n Value is for full Campaign period.

Project Emission:
Over the duration of the project activity, N_2O concentration and gas volume flow in the stack of the nitric acid plant as well as the temperature and pressure of ammonia gas flow and ammonia-to-air ratio have been measured continuously.

Estimation of campaign-specific project emissions:

PE_n = VSG * NCSG * OH * 10^-9

Where
VSG = Mean Stack Gas volume flow rate for the project campaign (m^3/h)
NCSG = Mean concentration of N_2O in the stack gas for the project campaign (mg N_2O/M^3)
OH = is the number of hours of operation in the specific monitoring period (h)
PE_n = Total N_2O emissions of the n^{th} project campaign (tN_2O)

Derivation of a moving average emission factor

Step 1:
Campaign specific emissions factor for each campaign is estimated during the project's crediting period by dividing the total mass of N_2O emissions during that campaign by the total production of 100% concentrated nitric acid during that same campaign

$EF_n = PE_n / NAP_n$

Results:

Parameter	Unit	Values During Monitoring Period
VSG	Nm^3/h	49949.39
NCSG	mgN_2O/ Nm^3	890.27
OH	Hours	1928
NAP	$tHNO_3$	28812.98
PE n	tN_2O	85.73
EF	**$tN_2O/tHNO_3$**	**0.00298**

Step 2: Estimate a moving average emissions factor is calculated at the end of a campaign 'n' as follows:

$EF_{ma,n} = (EF_1+EF_2+……..EF_n) / n$

And consider the maximum of $EF_{ma, n}$ and EF_n for estimation of project emissions.

Results:

Project Campaign 1:
As this is the first campaign in the project activity,

$EF_{ma, n} = EF_1$

Appendix I

Base Data (As validated during validation)

Parameter	Unit	Value
AFR max	$kgNH_3$/ h	5113
AIFR max	%	11.50%
OT normal	Deg C	863-900
OP normal	barg	660 – 626
GS BL		RCF
GC BL	-	Pt - 92%, Rh – 8%
NCSG BC	mgN_2O/ Nm^3	4054.1
VSG BC	Nm^3/h	49077
OH BC	hours	2861
NAP BC	$tHNO_3$	43326
CL BL	$tHNO_3$	43326
CL normal	$tHNO_3$	44435
GS normal	-	RCF
GC normal	-	Pt – 92%, Rh - 8%
Design Capacity	MT/ annum	128480

Historical Data:

Unit 1 : 352 TPD(HP) Campaign 1	Catalyst Running Hrs. : 2879
Date: 08.11.2005 to 12.03.2006	Production : 44469

Unit 1 : 352 TPD (HP) Campaign 2	Catalyst Running Hrs. : 2871
Date: 13.03.2006 to 14.11.2006	Production : 43796

Unit 1 : 352 TPD(HP) Campaign 3	Catalyst Running Hrs. : 2879
Date: 17/11/2006 to 17/06/2007	Production : 45570

Unit 1 : 352 TPD(HP) Campaign 4	Catalyst Running Hrs. : 2880
Date: 21/06/2007 to 18/01/2008	Production : 43715

Unit 1 : 352 TPD(HP) Campaign 5	Catalyst Running Hrs. : 2902
Date: 20/01/2008 to 01/07/2008	Production : 44625

Parameters	Unit	Historical Values (a)	Design Data (b)	Permitted Range (Conservative of a & b)
Oxidation Temp	Deg C	863-900	860-930	863-900
Oxidation Pr	barg	6.60-6.26	7.65	6.60 – 6.26
Ammonia Flow Rate (Max)	Nm3/ h	6725	-	-
Ammonia Flow Rate (Max)	kg/ h	5113	6076	5113
Ammonia - air ratio (Max)	%	11.9	11.5	10.3

Appendix II:

Technical Details of Monitoring Instruments:

Data Variable	Description	Data Unit	Instrument Type	Instrument Tag no.	Sr. No	Data of Previous calibration	Date of calibration	Calibration frequency	Due date of calibration
AFR	Amm gas to N 001	Nm3/h	D.P Type Transmitter	FT120 211A	S198 744	16/08/2008	17/08/2009	1 Year	17/08/2010
AFR	Amm gas to N 001	Nm3/h	D.P Type Transmitter	FT120 211B	S198 745	16/08/2008	17/08/2009	1 Year	17/08/2010
AFR	Amm gas to N 001	Nm3/h	D.P Type Transmitter	FT120 211C	S198 746	16/08/2008	19/08/2009	1 Year	19/08/2010
NA	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212 A	12099 36	16/08/2008	19/08/2009	1 Year	19/08/2010
NA	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212 B	12099 34	16/08/2008	19/08/2009	1 Year	19/08/2010
NA	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212 C	12099 37	14/08/2008	19/08/2009	1 Year	19/08/2010
NA	Amm - inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120212 A	NA	16/08/2008	19/08/2009	1 Year	19/08/2010
NA	Amm - inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120212 B	NA	16/08/2008	17/08/2009	1 Year	17/08/2010
NA	Amm - inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120212 C	NA	16/08/2008	17/08/2009	1 Year	17/08/2010
NA	Air Flow-N001	Nm3/h	D.P Type Transmitter	FT 120213 A	S198 740	14/08/2008	17/08/2009	1 Year	17/08/2010
NA	Air Flow-N001	Nm3/h	D.P Type Transmitter	FT 120213 B	S198 741	16/08/2008	17/08/2009	1 Year	17/08/2010
NA	Air Flow-N001	Nm3/h	D.P Type Transmitter	FT 120213 C	S198 742	16/08/2008	19/08/2009	1 Year	19/08/2010
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214A	S019 8760	14/08/2008	17/08/2009	1 Year	17/08/2010
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214B	S019 8761	14/08/2008	19/08/2009	1 Year	19/08/2010
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214C	S019 8762	14/08/2008	19/08/2009	1 Year	19/08/2010
NA	Air inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120214 A	NA	14/08/2008	17/08/2009	1 Year	17/08/2010
NA	Air inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120214 B	NA	14/08/2008	19/08/2009	1 Year	19/08/2010
NA	Air inlet to N001 temp	Deg. C	RTD with R/I converter	TT 120214	NA	14/08/2008	19/08/2009	1 Year	19/08/2010

				C					
OT	Catalyst Temp ROO1	Deg. C	Temp. Transmitter	TT1203 32A	19955 6	14/08/2008	18/08/2009	1 Year	18/08/20 10
OT	Catalyst Temp ROO1	Deg. C	Temp. Transmitter	TT1203 33A	19955 8	14/08/2008	18/08/2009	1 Year	18/08/20 10
OT	Catalyst Temp ROO1	Deg. C	Temp. Transmitter	TT1203 34A	19956 0	16/08/2008	18/08/2009	1 Year	18/08/20 10
NCS G	N2O Analyser	Mg/m3	N2O Analyser	AI 120400	02400 71228 /2400	27/02/2010	27/05/2010	3 Months	27/08/20 10
VSG	Stack Flow	mBar	D.P Type Transmitter	FI12040 0	265D S660 00283 31	01/07/2008	06/07/2009	1Year	06/07/20 10
PSG	Stack Pressure	hPa	Pressure Transmitter	PI12040 0	11894 9	01/07/2008	06/07/2009	1Year	06/07/20 10
TSG	Stack Temp	Deg. C	RTD with R/I converter	TI12040 0	NA	01/07/2008	06/07/2009	1Year	06/07/20 10
NAP	Product acid flow	T/h	Mass flow meter	FI10121	12031 565	NA	24/06/2008	3 Years	24/06/20 11
NA	Acid Density	gm/cc	Hydrometer	NA	NA	29/05/2009	30/11/2009	6 months	29/05/20 10
NA.	Acid Temperature	Deg C	Thermometer	NAG/L/T M-1	NA	10/10/2008	25/11/2009	1 Year	25/11/20 10

Appendix III

Abbreviations

RCF	Rashtriya Chemicals and Fertilizers Limited
CDM	Clean Development Mechanism
CEM	Continuous Emission Monitoring
GHG	Green House Gases
ER	Emission Reduction
BE	Baseline Emission
N_2O	Nitrous Oxide
NH_3	Ammonia
VSG	Volume flow rate of the Stack Gas
OH	Operating Hours
TSG	Temperature of Stack Gas
NAP	Nitric Acid Production
OT	Operating Temperature
OP	Operating Pressure
AFR	Ammonia Gas Flow Rate to AOR
AIFR	Ammonia to Air Ratio
GWP	Global Warming Potential