MONITORING REPORT
Version 1, 17/02/2011

Project Title : N2O abatement in HP Nitric Acid plants at Rashtriya Chemicals & Fertilizers Limited, India
Reference Number : 2792
Monitoring Period : 8th July 2010 to 04th December 2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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 (absolute) and High pressure unit at 7-8 bar (absolute) respectively, both the units are located at Trombay. The current project activity is based in the high pressure Nitric Acid unit of the fertilizer plant of RCF.

This project activity is in the process of nitric acid production which 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 purpose of the project activity is to reduce the emission of N_2O (a greenhouse gas) by installing of secondary DeN_2O 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 specialized catalyst was procured from well known supplier M/s BASF Germany. The N_2O decomposition catalyst has been installed down stream of Pt gauze. The project activity helps 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. EN14181 compliant continuous emission monitoring system was procured from M/s ABB Germany.

The DeN_2O catalyst was installed and commissioned on 31.03.2009.

The catalyst is in operation since then.

The Purpose of this monitoring report is to calculate and clarify the GHG emission reduction quantity achieved by this project for periodic verification. The total emission reduction during the verification period through this project activity is 1,36,762 tCO_2.

A.2. Project Participants

Rashtriya Chemicals & Fertilizers Ltd. (Public Entity)

A.3. Location of the project activity:

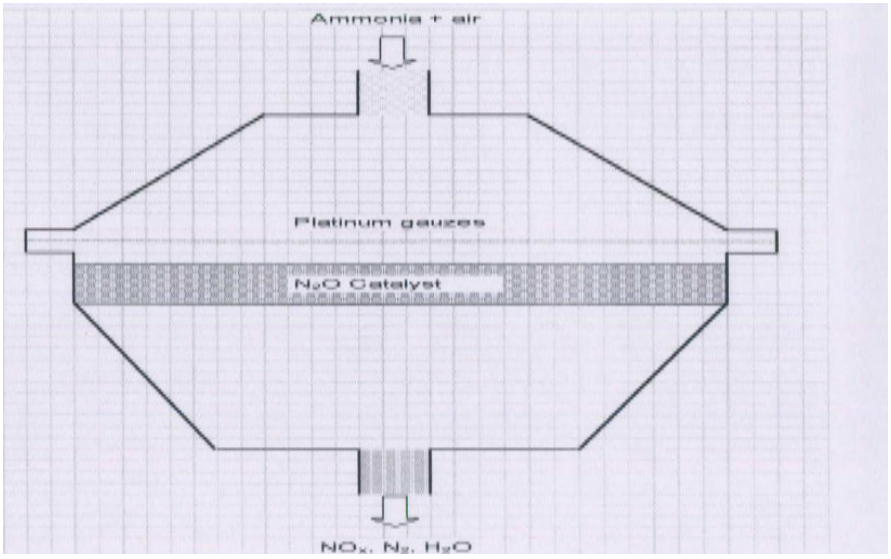
Host Country	:	India
State	:	Maharashtra
Town	:	Trombay, Sion
Latitude	:	$18^0$56'33" N
Longitude	:	$72^0$50'9" E

A.4. Technical description of the project

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 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:
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 rasching 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.

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

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

- Approved baseline methodology AM0034 **"Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants"**
  Reference: Version 03.2, Sectoral Scope 05, EB 41

- **Tool for the demonstration and assessment of additionality**
  Reference: Version 05.2, EB39

A.6. Registration date of the project activity:

20th November 2009

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Crediting Period: Renewable Period, 7 Years

Crediting Period Starts from 20th November 2009

A.8. Name of responsible person(s)/entity (ies):

Mr. A.B.Khare
Rashtriya Chemicals and Fertilizers Limited
10th Floor, Priyadarsini,
Eastern Express Highway,
Sion – Mumbai 400 022
Maharashtra, India.

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

Start date of operation of project activity:
The starting date of operation of this project activity is 31.03.2009
Catalyst was in operation during whole campaign period ie from 8th July 2010 to 04th December 2010.

There was no exchange of equipment since installation of catalyst**.**

Shutdown details of equipment:
Please refer Appendix-II for details.

Events that may impact the applicability of methodology:
There are no events or situation which impacts the applicability of the methodology during the monitoring period.

How the issues resulting from the events are being addressed:
Not applicable.

B.2. Revision of the monitoring plan

NA

B.3. Request for deviation applied to this monitoring period

NA

B.4. Notification or request of approval of changes

NA

SECTION C. Description of the monitoring system

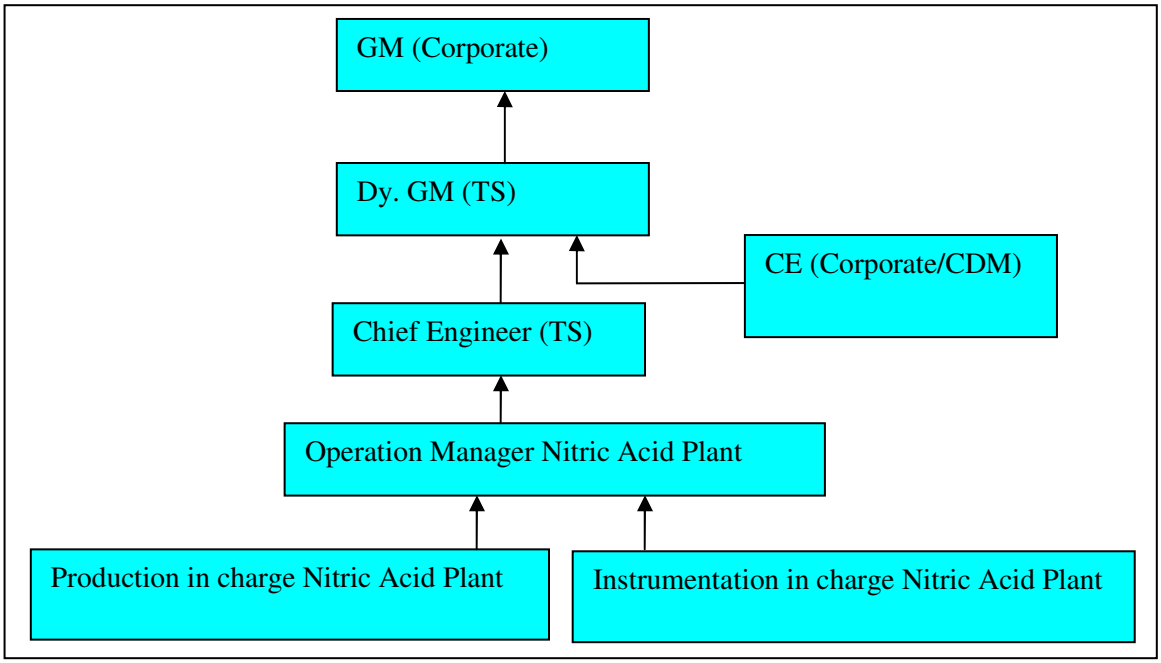
RCF is an ISO 9001 certified company and has procedure for monitoring and recording of data on operation of the plant/ equipments. ISO 9001 procedures have been formulated for all new monitoring instruments. All instruments used for CDM project monitoring are calibrated as per ISO 9001 procedures.

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 are 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.

Daily report (Hourly average, in pdf format) from CEM system is archived by plant personnel and forwarded to CDM team members. Corporate CDM team member convert these PDF file in excel format and consolidate the data for entire campaign. Consolidated data is used for emission reduction calculation for final verification by verifier.

Organizational structure for monitoring plan



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

1.1 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

1.2 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 has been implemented. These three levels are QAL1, QAL2 and QAL3.

QAL1 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 QAL3, the analyzer carries out auto calibration on weekly basis. Annual Surveillance test (AST) is also carried out by third party as a part of EN 14181, QAL3 procedures. AST was carried out by SGS Netherland.

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

2.1 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

2.2 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,

2.3 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.

2.4 Sample Conditioning System

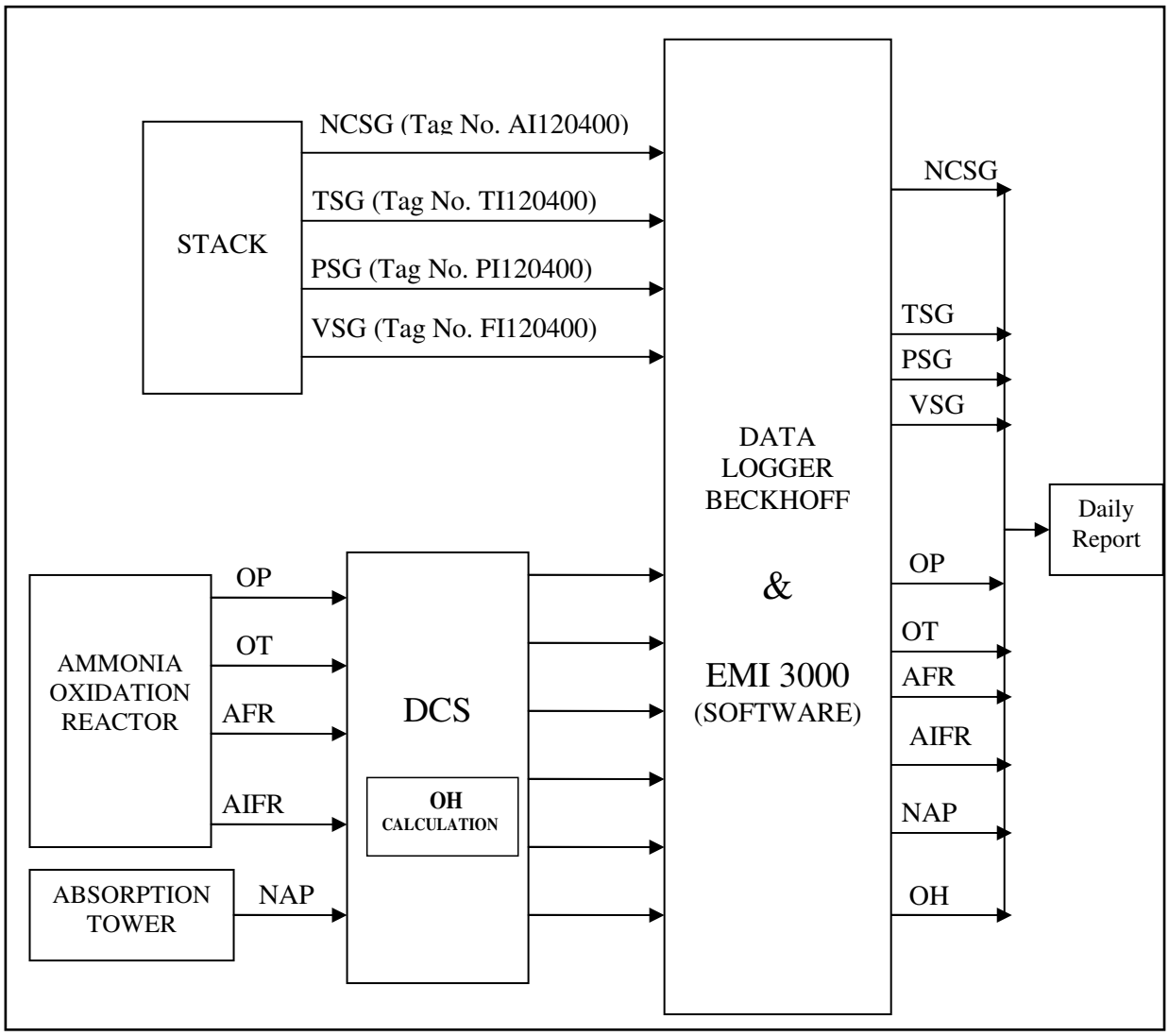
The gas sample is extracted at the sampling point, particles are removed by the heated filter unit and the clean sample gas is delivered through a heated sampling line to the analyser cabinet. Before being fed to the analyser, moisture is removed by the sample gas cooler and sample gas feed unit installed 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.

2.5 Flow Meter

The SDF Flow measuring system allows continuous determination of the flow rate of stack gas. It is performance tested according to 17.BImSchV and "TA Luft" (test report No. 936/802015, TUV Rheinland 1993) for use in plants. The unit's suitability was tested by TUV Rheinland Germany.

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 Data Logger has been calibrated by ABB Germany during manufacturing stage and calibration was again rechecked during QAL2 test by TUV SUD Germany.

LINE DIAGRAM FOR MONITORING POINTS OF HP NITRIC ACID PLANT



The ABB's Differential pressure type transmitter is used for stack gas flow measurement which gives 4-20 mA signal which is directly proportional to the stack gas flow. The Differential pressure transmitter signal is fed 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 fed 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.

2.6 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.

3. Emergency preparedness

The maximum emissions possible during the crediting period, in case of emergency situation like complete deactivation of DeN_2O catalyst shall be same as that of base line emissions.

The emissions are monitored using CEM system which complies with EN14181 as required by the methodology in the project activity.

It is expected that all the instruments shall be functioning continuously for recording data. However in case of emergency of breakdown of Automated measuring system (AMS) RCF will follow the procedure mentioned in the methodology

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 -
Failure of N_2O Analyzer (NCSG)	In case N_2O analyzer is not functioning, data for the period shall be taken as highest measured value during the campaign for calculating the campaign average.
Failure of Stack gas Flow meter (VSG)	In case Stack gas flow meter is not functioning, data for this period shall be replaced with highest measured value during the campaign for calculating the campaign average..
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 hour counter 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. In case concentration of nitric acid has not been determined 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.
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.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**AFR_{max}**
Data unit:	Nm^3/hr
Description:	Maximum Ammonia Flow Rate
Source of data used:	Plant Records
Value(s) :	7992 (This is equivalent to 6.076 tNH_3/h)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	The methodology gives the unit of measurement in tNH_3/h but RCF have been measuring the parameter in Nm^3/h in the past. The conversion factor from Nm^3/h to Kg/h is 0.7602 (which is 17. 03/22.4). RCF has converted this measured value in Kg/h for the project activity.

Data / Parameter:	$AIFR_{max}$
Data unit:	%
Description:	Maximum ammonia to air ratio
Source of data used:	Calculated
Value(s) :	11.5
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission/Project Campaign
Additional comment:	-

Data / Parameter:	OT_{normal}
Data unit:	Deg C
Description:	Normal Operating Temperature
Source of data used:	Monitored
Value(s) :	Max = 930 Min = 860
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

Data / Parameter:	OP_{normal}
Data unit:	Bar (gauge)
Description:	Normal operating pressure
Source of data used:	Monitored
Value(s) :	Max = 7.65 (765 kPa) (gauge)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	1 Pa = 10^-5 bar. Methodology gives unit of measurement in Pa. But RCF were measuring this parameter in bar. In the project activity however, RCF has converted this measuring value in kPa for the project activity

Data / Parameter:	GS_{BL}
Data unit:	-
Description:	Gauze Supplier for the baseline campaign
Source of data used:	Monitored
Value(s) :	Rashtriya Chemicals & Fertilizer Ltd
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	Rashtriya Chemicals & Fertilizers limited is getting fabricated the catalyst gauze from three vendors (Baseline Vendor RHPL) RHPL/

	HPL / Aurora Mathey, on labour charge basis, giving them metal and specification of catalyst.

Data / Parameter:	**GC_{BL}**
Data unit:	**-**
Description:	Gauze Composition during Baseline Campaign
Source of data used:	Monitored
Value(s) :	Pt – 92%, Rh – 8%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

Data / Parameter:	**$NCSG_{BC}$**
Data unit:	mgN_2O/Nm^3
Description:	N2O Concentration in the stack gas
Source of data used:	N2O analyser
Value(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the NCSG value was 4054.1 mg N_2O/Nm^3
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	Regular Calibration is done according to ISO 9001 procedure. This analyser is tested as per QAL2 test of recognised industry standards (EN 14181) by third party TUV SUD, Germany. Staff has been trained in maintenance of monitoring Instrument. Staff is also trained in monitoring procedures and a reliable technical support infrastructure is set up.

Data / Parameter:	**VSG_{BC}**
Data unit:	Nm^3/h
Description:	Volume flow rate of the stack gas
Source of data used:	From CEM system supplied by M/s. ABB along with analyser
Value(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the VSG value was 49077.4 Nm^3/h
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	Regular Calibration is done according to ISO 9001 procedure. This analyser is tested as per QAL 2 test of recognised industry standards (EN 14181) by third party TUV SUD, Germany. Staff is also trained in monitoring procedures and a reliable technical support infrastructure is set up.

Data / Parameter:	**OH_{BC}**
Data unit:	Hours

Description:	Operating Hours
Source of data used:	From CEM System
Value(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the OH value was 2861 hours.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	Included in evaluation by third party validator.

Data / Parameter:	**NAP_{BC}**
Data unit:	$tHNO_3$
Description:	Nitric Acid (as 100%) over baseline campaign
Source of data used:	This is calculated data based on the following: 1) Mass flow rate of dilute nitric acid from mass flow meter. 2) Average concentration of nitric acid for the day, determined in the plant laboratory.
Value(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the NAP value was 43,326 $tHNO_3$.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	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 9001 procedures. In case mass flow meter is not functioning for any period during the day, Nitric acid production for the day is calculated using average ammonia specific consumption for previous operating days and ammonia consumption for plant for the day from meter no. FI 120101. The calculated production value for the day is used for further processing; all other data from nitric acid mass flow meter for this day is ignored. In case concentration of nitric acid has not been determined for the day due to any reason like shut down, start up etc, then; • In case of shut down data for concentration is taken from previous day • In case of start up data for concentration is taken from next day. • In case of shut down and start up both data for concentration is 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 is taken for correctness of

	data based on reason of not availability. He gives decision whether previous day data to be used or next day data to be used. Conservativeness of the value will be maintained Operation Manager nitric acid plant takes 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:	**CL_{BL}**
Data unit:	$tHNO_3$
Description:	Length of Baseline Campaign
Source of data used:	As per the Production Data
Value(s) :	43,326
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

Data / Parameter:	**CL_{Normal}**
Data unit:	$tHNO_3$
Description:	Normal Campaign Length
Source of data used:	Calculated from nitric acid production data
Value(s) :	44,435
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

Data / Parameter:	**GS_{Normal}**
Data unit:	**-**
Description:	Normal gauze supplier for the operating conditions campaigns, there are three gauge fabricators for RCF, they work on labour charge basis for gauze fabrication, precious metal and specification is given by RCF. Hence RCF is the gauze supplier.
Source of data used:	Plant Data
Value(s) :	Rashtriya Chemicals and Fertilizer Ltd.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	Frequency of recording: Each Campaign (Rashtriya Chemicals & Fertilizers limited is getting fabricated the catalyst gauze from any one of the three parties RHPL/ HPL/ Aurora Mathey, on labour charge basis, giving them metal and specification of catalyst)

Data / Parameter:	**GC_{Normal}**
Data unit:	**-**
Description:	Gauze Composition during the operating campaign

Source of data used:	Monitored
Value(s) :	Pt – 92%, Rh – 8%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	**NCSG**
Data unit:	mgN_2O/Nm^3
Description:	N_2O concentration in the stack gas
Measured /Calculated /Default:	Measured
Source of data:	N_2O Analyser
Value(s) of monitored parameter:	784.15
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emission
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every two seconds
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. The repeatability of this instrument is $\leq$ 0.5% of span.
Calculation method (if applicable):	-
QA/QC procedures applied:	N_2O monitor have auto calibration feature. Regular Calibrations according to ISO 9001 procedure and this analyzer was tested as per QAL2 test of recognized industry standards (EN 14181) by third party TUV SUD, Germany. Staffs have been trained in monitoring procedures and a reliable technical support infrastructure has been set up.

Data / Parameter:	**VSG**
Data unit:	Nm^3/h
Description:	Volume flow rate of the stack gas
Measured /Calculated /Default:	Measured
Source of data:	From CEM System
Value(s) of monitored	48,371.58

parameter:	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emission
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every two seconds
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. The base accuracy of this instrument is ± 0.04%.
Calculation method (if applicable):	-
QA/QC procedures applied:	Regular Calibrations according to ISO 9001 procedures and this instrument was tested as per QAL2 test of recognized industry standards (EN14181) by third party TUV SUD, Germany.

Data / Parameter:	**OH**
Data unit:	Hours
Description:	Operating hours
Measured /Calculated /Default:	Calculated
Source of data:	From CEM system
Value(s) of monitored parameter:	2873
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emission
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of recording: Hourly compiled for entire campaign
Description of measurement methods and procedures to be applied:	As soon as ammonia is introduced in the reactor OH counter starts automatically. Similarly when ammonia flow to reactor is cut off OH counter is stopped automatically.
Calculation method (if applicable):	-
QA/QC procedures applied:	Included in evaluation by third party validator.

Data / Parameter:	**NAP**
Data unit:	$tHNO_3$

Description:	Nitric Acid (As 100%)
Measured /Calculated /Default:	Calculated
Source of data:	This is a calculated data based on the following 1. Mass flow rate of dilute nitric acid from mass flow meter. 2. Average Concentration of nitric acid for the day determined in the plant laboratory.
Value(s) of monitored parameter:	45,620
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emission
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Hourly compiled for entire campaign
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. 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. Conservativeness of the value will be maintained. 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. The NAP value is calculated based on the mass flow of dilute Nitric acid and the acid concentration. The Concentration of Nitric acid is determined by using Hydrometer (least count = 0.001) and Thermometer (least count =1). The instrument accuracy of Mass flow measurement of dilute Nitric acid is ± 0.1% of rate.
Calculation method (if applicable):	-
QA/QC procedures 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 9001 Procedures.

Data / Parameter:	**TSG**
Data unit:	Deg C
Description:	Temperature of stack gas
Measured /Calculated /Default:	Measured
Source of data:	Continuous Emission Monitoring system from ABB
Value(s) of monitored parameter:	Continuously Monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	-
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every two seconds
Description of measurement methods and procedures to	Temperature transmitter coupled with Annubar (FI 120400) Tag no. TI 120400 (part of gas volume flow meter). The accuracy of this

be applied:	instrument is < 0.1 % FS.
Calculation method (if applicable):	-
QA/QC procedures applied:	Regular calibrations according to ISO 9001 procedure and this instrument were tested as per QAL2 test of recognized industry standards (EN 14181) by Third Party TUV SUD, Germany.

Data / Parameter:	**PSG**
Data unit:	hPa
Description:	Pressure of stack gas
Measured /Calculated /Default:	Measured
Source of data:	Continuous Emission monitoring system from ABB
Value(s) of monitored parameter:	Continuously Monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	-
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of recording: Every two seconds
Description of measurement methods and procedures to be applied:	Pressure transmitter coupled with Annubar (FI 120400) Tag no. PI 120400. (part of gas volume flow meter) The accuracy of this instrument is 0.5 % FSO.
Calculation method (if applicable):	.
QA/QC procedures applied:	Regular calibrations according to ISO 9001 procedure and this instrument were tested as per QAL2 test of recognized industry standards (EN 14181) by Third Party TUV SUD, Germany.

Data / Parameter:	**AFR**
Data unit:	Kg NH_3/h
Description:	Ammonia gas flow rate to AOR
Measured /Calculated /Default:	Measured
Source of data:	From CEM System
Value(s) of monitored parameter:	Continuously Monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emission
Monitoring equipment (type, accuracy class, serial	Given in Appendix III

number, calibration frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Continuous.
Description of measurement methods and procedures to be applied:	To be obtained from operating condition campaign. Ammonia flow meter is used. Transmitted from DCS. The accuracy of this instrument is ± 0.075 % of span.
Calculation method (if applicable):	-
QA/QC procedures applied:	Included in evaluation by third party validator

Data / Parameter:	**UNC**
Data unit:	%
Description:	Overall measurement uncertainty of the monitoring system
Measured /Calculated /Default:	Calculated
Source of data:	Calculated combined uncertainty factor determined by M/s TUV SUD, during QAL2 Test of monitoring equipment as per EN14181 guide line.
Value(s) of monitored parameter:	4.52
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of recording: Once after monitoring system is commissioned.
Description of measurement methods and procedures to be applied:	QAL2 test by third party validator M/s. TUV SUD, Germany of Instrument as per guideline of EN14181
Calculation method (if applicable):	UNC value was calculated as part of QAL2 procedures of EN14181.
QA/QC procedures applied:	This value is calculated by Third party TUV SUD Germany

Data / Parameter:	**AIFR**
Data unit:	-
Description:	Ammonia to Air ratio
Measured /Calculated /Default:	Measured
Source of data:	From CEM System
Value(s) of monitored parameter:	Obtained from DCS
Indicate what the data are	Project

used for (Baseline/ Project/ Leakage emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of recording: Every Hour.
Description of measurement methods and procedures to be applied:	Ratio is obtained from Ammonia flow Tag no FY 120211-M and Air Flow tag no FI 120213, transmitted from DCS. Accuracy of ammonia flow and air flow is ± 0.075% of span.
Calculation method (if applicable):	Ratio is obtained from Ammonia flow Tag no FY 120211-M and Air Flow tag no FI 120213, transmitted from DCS
QA/QC procedures applied:	Regular calibrations are carried out for Ammonia Flow meter FY 120211-M and Air Flow meter FI 120213 as per ISO 9001 procedure.

Data / Parameter:	**OT_h**
Data unit:	Deg C
Description:	Oxidation temperature of each hour
Measured /Calculated /Default:	Measured
Source of data:	Continuous Emission Monitoring (CEM) system from ABB.
Value(s) of monitored parameter:	Continuously monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every hour
Description of measurement methods and procedures to be applied:	Transmitted from DCS. There are three duplex K type thermocouples are installed in reactor. These are used for temperature measurement, with Tag No. TI120332A, TI120333A and TI120334A. The accuracy of this instrument is ± 0.03 %of span.
Calculation method (if applicable):	Not Applicable
QA/QC procedures applied:	Instruments are regularly calibrated as per ISO 9001 procedure.

Data / Parameter:	**OP_h**
Data unit:	kPa (gauge)
Description:	Oxidation pressure of each hour
Measured /Calculated	Measured

/Default:	
Source of data:	Continuous Emission Monitoring (CEM) system from ABB.
Value(s) of monitored parameter:	Continuously monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every hour
Description of measurement methods and procedures to be applied:	Oxidation Pressure is measured by pressure transmitter tag no PT 120212A/B/C. The accuracy of this instrument is ± 0.075 % of span.
Calculation method (if applicable):	Not Applicable
QA/QC procedures applied:	Instruments are regularly calibrated as per ISO 9001 procedure.

Data / Parameter:	**$GS_{project}$**
Data unit:	-
Description:	Gauze Supplier for project campaign
Measured /Calculated /Default:	Measured
Source of data:	Plant Data
Value(s) of monitored parameter:	Rashtriya Chemicals & Fertilizer Ltd.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix III
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every Campaign
Description of measurement methods and procedures to be applied:	Rashtriya Chemicals & Fertilizers limited is getting fabricated the catalyst gauze from any one of the three parties RHPL/ HPL/ Aurora Mathey, on labour charge basis, giving them metal and specification of catalyst
Calculation method (if applicable):	Not Applicable
QA/QC procedures applied:	Not Applicable

Data / Parameter:	**$GC_{project}$**
Data unit:	-
Description:	Gauze Composition during project campaign
Measured /Calculated /Default:	Measured
Source of data:	Monitored
Value(s) of monitored parameter:	Pt - 92%, Rh - 8%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not Applicable
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every Campaign
Description of measurement methods and procedures to be applied:	Rashtriya Chemicals & Fertilizers limited is getting fabricated the catalyst gauze from any one of the three parties RHPL/ HPL/ Aurora Mathey, on labour charge basis, giving them metal and specification of catalyst
Calculation method (if applicable):	Not Applicable
QA/QC procedures applied:	Precious metal composition is checked by Third Party Ledoux & Company

Data / Parameter:	**EF_{reg}**
Data unit:	
Description:	Emissions level set by incoming policies or regulations
Measured /Calculated /Default:	Not Applicable
Source of data:	Maharashtra Pollution Control Board
Value(s) of monitored parameter:	Currently India does not have any regulation w.r.t. N_2O emissions
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not Applicable
Measuring/ Reading/ Recording frequency:	-
Description of measurement	Currently there is no regulation for N_2O emission. The new regulation

methods and procedures to be applied:	will get reflected in consent to operate the plants. Consent to operate will be checked for N_2O emission applicability for each campaign
Calculation method (if applicable):	Not Applicable
QA/QC procedures applied:	Updated when new regulations comes into force

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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	4054.10
Operating hours	h/campaign	2861
Baseline emissions	tN_2O/ campaign	569.23
Uncertainty UNC	%	4.52%
HNO_3 production	$tHNO_3$/ campaign	43326
N_2O emission factor – baseline	**tN_2O/ $tHNO_3$**	**0.0125**

The CEM down time details is given in Annexure I. The lowest value between the IPCC default value and the last measured value is used in the down time period for the baseline emission factor. There is no change in the baseline emission factor as given in the registered PDD while considering the lowest value in the down time period.

Project Campaign Length:

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

a) 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.

b) If $CL_n \geq CL_{normal,}$ then all N_2O values measured during the project campaign can be used for the calculation of EF (subject to the elimination of data from the Ammonia/Air analysis).

Project Campaign 3:

No.	Description	Unit	Value
1	CL_3	$tHNO_3$	45,620
2	CL_{normal}	$tHNO_3$	44,435
3	CL_{BL}	$tHNO_3$	43,326

Here CL_n is greater than $CL_{normal,}$ hence baseline is applicable.

E.2. Project emissions calculation

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/Nm^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	48371.58
NCSG	mgN_2O/ Nm^3	784.15
OH	Hours	2873
NAP	$tHNO_3$	45620
PE 3	tN_2O	108.97
EF 3	**$tN_2O/tHNO_3$**	0.0024

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 3:
Emission factors for first, second & third campaigns in the project activity are as follows:

$EF_1 = 0.0031$

$EF_2 = 0.0030$

$EF_3 = 0.0024$

Moving Average Emission Factor = $EF_{ma,\ 3} = (EF_{1,} + EF_2 + EF_3) / 3$
$= (0.0031 + 0.0030 + 0.0024)$
$= 0.0028$

EF for the Project = $EF_p = Max\ (EF_{ma,\ 3}, EF_3)$
$= Max\ (0.0028, 0.0024)$
$= 0.0028$

E.3. Leakage calculation

No leakage calculation is required.

E.4. Emission reductions calculation / table

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:

Parameter	Unit	Values During Monitoring Period
NAP	$tHNO_3$	45619.96
EF_{BL}	$tN_2O/tHNO_3$	0.0125
EF_p	$tN_2O/tHNO_3$	0.0028
GWP_{N2O}	tCO_2/tN_2O	310

ER = (0.0125 - 0.0028) * 45619.96 * 310
= 1,36,762 tCO_2

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	For 365 days 4,47,305 hence for 119 days 1,46,397	1,36,762

E.6. Remarks on difference from estimated value in the PDD

The emission reduction during this monitoring period is 1,36,762 tCO_2e which is less than the ex – ante value of 1,46,397 tCO_2e mainly due to lower catalyst efficiency of 81% as against the estimated catalyst efficiency of 90%.

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	Bar(guage)	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	-	Rashtriya Chemicals & Fertilizer Ltd
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
Oxidation Temp	Deg C	863-900	860-930	860-930
Oxidation Pr	bar(g)	6.60-6.26	7.65	7.65
Ammonia Flow Rate (Max)	Nm3/ h	6725	7992	7992
Ammonia Flow Rate (Max)	kg/ h	5113	6076	6076
Ammonia - air ratio (Max)	%	11.9	11.5	11.5

Appendix-II

HP NA Plant shutdown/start-up and CEM System down time details

CEM system down time records during monitoring period:

The details for down time of CEM system for monitoring various parameters for HP Nitric acid Plant is as follows:

Sr. No.	From	To	Reason
1	19.07.2010 02:00	19.07.2010 08:00	Test gas knob remained in atmosphere mode
2	05.11.2010 01:00	05.11.2010 08:00	Cooler temperature too low

Plant Shutdown / Start-up records during monitoring period:

HP Nitric acid Plant shutdown and start-up records during the monitoring period is as follows

Sr. No.	Plant Shutdown From	Plant Shutdown up-to
1	07.07.2010 24:00 (campaign 2 end)	
2	-	08.07.2010 01:00 (Campaign 3 Start)
3	08.07.2010 01:00	19.07.2010 01:00
4	29.07.2010 17:00	07.08.2010 01:00
5	03.09.2010 16:00	03.09.2010 21:00
6	14.09.2010 11:00	19.09.2010 09:00
7	19.09.2010 22:00	20.09.2010 12:00
8	29.09.2010 13:00	01.10.2010 17:00
9	04.11.2010 12:00	05.11.2010 00:00
10	17.11.2010 19:00	17.11.2010 23:00
11	21.11.2010 20:00	22.11.2010 01:00
12	27.11.2010 16:00	27.11.2010 17:00
13	30.11.2010 13:00	30.11.2010 16:00
14	04.12.2010 04:00	04.12.2010 23:00
15	04.12.2010 23:00 (Campaign 3 End)	-

Appendix-III

Technical Details of Monitoring Instruments:

Data Variable	Description	Data Unit	Instrument Type	Instrument Tag no.	Sr. No.	Accuracy	Data of Previous calibration	Date of calibration	Calibration frequency	Due date of calibration	Calibration Agency
AFR	Amm gas to N 001	Nm3/Hr	D.P Type Transmitter	FT120 211A	S19874 4	± 0.075% of span	17/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
AFR	Amm gas to N 001	Nm3/Hr	D.P Type Transmitter	FT120 211B	S19874 5	± 0.075% of span	17/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
AFR	Amm gas to N 001	Nm3/Hr	D.P Type Transmitter	FT120 211C	S19874 6	± 0.075% of span	19/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
OP	Amm - inlet to N001	Bar (gauge)	Pressure Transmitter	PT 120212 A	120993 6	± 0.075% of span	19/08/20 09	04/08/20 10	1 Year	04/08/20 11	Plant
OP	Amm - inlet to N001	Bar (gauge)	Pressure Transmitter	PT 120212 B	120993 4	± 0.075% of span	19/08/20 09	04/08/20 10	1 Year	04/08/20 11	Plant
OP	Amm - inlet to N001	Bar (gauge)	Pressure Transmitter	PT 120212 C	120993 7	± 0.075% of span	19/08/20 09	04/08/20 10	1 Year	04/08/20 11	Plant
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212 A	NA	Deviation after calibration : 0.1% of F.S. value	19/08/20 09	02/08/20 10	1 Year	02/08/20 11	Plant
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212 B	NA	Deviation after calibration : 0.1% F.S. value	17/08/20 09	02/08/20 10	1 Year	02/08/20 11	Plant
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212 C	NA	Deviation after calibration : 0.1% F.S. value	17/08/20 09	02/08/20 10	1 Year	02/08/20 11	Plant
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213 A	S19874 0	± 0.10% of span	17/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213 B	S19874 1	± 0.10% of span	17/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213 C	S19874 2	± 0.10% of span	19/08/20 09	06/08/20 10	1 Year	06/08/20 11	Plant
NA	Air inlet to N001	Bar (gauge)	Pressure Transmitter	PT120 214A	S01987 60	± 0.075% of span	17/08/20 09	05/08/20 10	1 Year	05/08/20 11	Plant
NA	Air inlet to N001	Bar (gauge)	Pressure Transmitter	PT120 214B	S01987 61	± 0.075% of span	19/08/20 09	05/08/20 10	1 Year	05/08/20 11	Plant
NA	Air inlet to N001	Bar (gauge)	Pressure Transmitter	PT120 214C	S01987 62	± 0.075% of span	19/08/20 09	05/08/20 10	1 Year	05/08/20 11	Plant

NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214 A	NA	Deviation after calibration : 0.1% of F.S. value	17/08/2009	04/08/2010	1 Year	04/08/2011	Plant
NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214 B	NA	Deviation after calibration : 0.1% of F.S. value	19/08/2009	04/08/2010	1 Year	04/08/2011	Plant
NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214 C	NA	Deviation after calibration : 0.1% of F.S. value	19/08/2009	04/08/2010	1 Year	04/08/2011	Plant
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT120332A	199556	D/A Accuracy ± 0.03% of span	18/08/2009	02/08/2010	1 Year	02/08/2011	Plant
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT120333A	199558	D/A Accuracy ± 0.03% of span	18/08/2009	02/08/2010	1 Year	02/08/2011	Plant
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT120334A	199560	D/A Accuracy ± 0.03% of span	18/08/2009	02/08/2010	1 Year	02/08/2011	Plant
NCSG	N2O Analyser	Mg/m3	N2O Analyser	AI 120400	0240071228/2400	Repeatability ≤ 0.5% of span	28/05/2010	28/08/2010 19/11/2010	3 Months	19/02/2011	Plant
VSG	Stack Flow	mBar	D.P Type Transmitter	FI120400	265DS6600028331	Base Accuracy ± 0.04%	06/07/2009	08/07/2010	1Year	08/07/2011	Instrument Workshop
PSG	Stack Pressure	hPa (absolute)	Pressure Transmitter	PI120400	1198949	0.5% of FSO	06/07/2009	08/07/2010	1Year	08/07/2011	Instrument Workshop
TSG	Stack Temp	Deg.cent	RTD with R/I converter	TI120400	NA	Linearity error : <0.1 % FS	06/07/2009	08/07/2010	1Year	08/07/2011	Instrument Workshop
NAP	Product acid flow	T/hr	Mass flow meter	FI10121	SEN.-12031565, TRANS.-3781972	± 0.1% of rate	24/06/2008		3 Years	24/06/2011	External Agency
NA	Acid Density	gm/cc	Hydrometer	NA	NA	Least count: 0.001	28/05/2010	17/11/2010	6 months	16/05/2011	Instrument Workshop
NA.	Acid Temperature	Deg C	Thermometer	NAG/L/TM-1	NA	Least count: 1	25/11/2009	18/11/2010	1 Year	18/11/2011	Instrument Workshop

Appendix -IV

Details of Calibration Procedures:

1. Work Instructions for calibration of DP Transmitter:

i) Take necessary clearance from process department for calibration of instrument.
ii) Issue job to the technician.
iii) Isolate and drain the transmitter from manifold.
iv) Connect master multi-meter to the transmitter. Check for correct polarity.
v) Connect output of pneumatic calibrator to transmitter HP/LP leg as required.
vi) Feed 0-25-50-75-100% impulse and note the output readings. If all out put current are with in allowable tolerance then the calibration is completed else.
vii) Feed 0% signal and adjust 4mA.
viii) Feed 100% signal and adjust 20mA.
ix) Repeat steps 6 & 7, till the instrument range is adjusted.
x) Check output for 0-25-50-75-100%, if all out put values are with in allowable tolerance then the calibration is completed or repair / replace the instrument and repeat calibration process from step no.5.Note the readings corresponding to 0-25-50-75-100%.
xi) Disconnect the calibrating instruments and intimate process department regarding completion of job. Take the transmitter in line.
xii) Enter the calibration results in calibration record.

2. Work Instructions for calibration of Pressure Transmitter:

i) Take necessary clearance from process department for calibration of instrument.
ii) Isolate and drain the transmitter from manifold, remove the connections and then
    a) Remove the transmitter.
    b) Install the transmitter on the dead weight tester or connect parallel to Master Pressure Gauge/Instrument.
iii) Connect power supply to the transmitter then connect master multimeter to the transmitter.
iv) Feed 0-25-50-75-100% impulse and note the out put readings. If all out put values are with in allowable tolerance then the calibration is completed else.
v) Feed 0% signal and adjust 4 mA.
vi) Feed 100% signal and adjust 20 mA.
vii) Repeat steps 5 & 6, till no further adjustments are required.
viii) Check output for 0-25-50-75-100%, if all out put values are with in allowable tolerance then the calibration is completed or replace the instrument and repeat calibration process from step no.4. Note the readings corresponding to 0-25-50-75-100%.
ix) Restore the connections of calibrating instruments and take the transmitter in line.
x) Inform process department regarding completion of job.
xi) Enter the calibration results in calibration record.

3. Work Instructions for calibration of Temperature Transmitter:

i) Take necessary clearance from process department for calibration of instrument.
ii) Remove temperature element connections to the transmitter.
iii) Connect the temperature calibrator to the transmitter. Select mode of the calibrator depending upon the type of temperature element.

iv) Feed 0-25-50-75-100% input to the transmitter and check out put readings. If all out put values are with in allowable tolerance then the calibration is completed else.
v) Feed 0% signal and adjust 4 mA.
vi) Feed 100% signal and adjust 20 mA.
vii) Repeat steps 5 & 6, till no further adjustments are required.
viii) Check output for 0-25-50-75-100%, if all out put values are with in allowable tolerance then the calibration is completed or replace the instrument and repeat calibration process from step no.3. Note the readings corresponding to 0-25-50-75-100%.
ix) Disconnect the calibrating instruments and take the transmitter in line. Intimate completion of job to Production Department.
x) Enter the calibration results in calibration record.

4. Work Instructions for calibration of N_20 analyzer:

i) Take necessary clearance from process department for calibration of instrument.
ii) Press "S2" switch to ON position for carrying out calibration of N20 analyzer.
iii) Change the gas knob by hand to air side (external sample side).
iv) Ensure that the sample flow rate is 60LPH.
v) For zero gas calibration press - Menu then select Calibration then select manual calibration then select zero gas and press enter.
vi) Wait till the reading gets stabilize and then press enter.
vii) For Span gas calibration connect known N_20 cylinder then press – Menu then select Calibration then select manual calibration then select span gas and press enter.
viii) Wait till the reading gets stabilize and then press enter.
ix) For Cal. Cell calibration press – Menu then select Calibration then select manual calibration then select Cal. Cell and press enter.
x) Wait till the reading gets stabilize and then press enter.
xi) Measure/ monitor the N_20 on screen or measure the 4-20mA output.
xii) Press back button. Turn the gas knob to the sample side.
xiii) Enter the calibration results in calibration record.
xiv) Press "S2" switch to OFF position after completion of calibration of N_20 analyzer.
xv) Actual N_20 in ppm will be displayed on the analyzer screen.

5. Work Instructions for calibration of hydrometer:

Calibration of Hydrometer:

i) Take clean dry measuring cylinder of 100 ml.
ii) Ensure the cylinder is properly cleaned and dried.
iii) Fill measuring cylinder with the solution having specific gravity, which is in the range of Hydrometer is to be calibrated.
iv) Dip the calibrated hydrometer (calibrated from external agency). Allow to stand in solution for 2-3 min to get stabilized.
v) Note down the reading.
vi) Determine the density of the solution.
vii) Remove the Hydrometer.
viii) Now dip the Hydrometer which is to be calibrated. Allow to stand for 2-3 min.
ix) Note down the reading.
x) Note down the variation.

xi) Now take another solution having slightly lower specific gravity in another dry and clean measuring cylinder of 100 ml.
xii) Repeat the same experiment.
xiii) Then repeat the same experiment by taking another solution of higher density.
xiv) If there is large variation in reading the Hydrometer is to rejected and if variation is within the range accepted for regular use.
xv) Calibration is over Hydro meter is ready for specific gravity determination.

Work instructions for sample analysis:

i) Take the solution whose specific gravity to be determined.
ii) Select the Hydrometer of proper range.
iii) Take clean dry measuring cylinder of 100ml.
iv) Ensure the cylinder is properly cleaned and dried.
v) Fill measuring cylinder with the solution.
vi) Dip the calibrated hydrometer. Allow to stand in solution for 2-3 min to get stabilized.
vii) Note down the specific gravity.

6. Work Instructions for calibration of temperature gauge/ element / transmitters:

i) Temperature gauge/ element/ Transmitter along with the Job Card are received at inst. Workshop.
ii) Entry to be done in IN/OUT Register.
iii) Job to be allotted to technician as per instruction on job card.
iv) Calibration to be done by using Master Temperature Calibrator.
v) Insert gauge sensor or Element in temperature calibrator and set temperature on calibrator.
vi) Take readings at 0%,25%,50%,75% of the total temperature range.
vii) The record of calibration is to be entered in calibration report file.
viii) The temperature gauges/Transmitters after calibration are to be affixed with a label sticker.
ix) If they are found out of order, to be labeled as faulty.
x) Job is to be kept in out Section and ready to send to plant.
xi) Entry to be done in IN/OUT Register.

Appendix - V

Abbreviations

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