

**MONITORING REPORT**

Version 1, 28/09/2010

Project Title : N₂O abatement in HP Nitric Acid plants at Rashtriya Chemicals & Fertilizers Ltd, India
Reference Number : 2792
Monitoring Period : 13th February 2010 to 07th July 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 and High pressure unit at 7-8 bar 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 NO₂, which is converted into Nitric Acid by absorbing NO₂ in water. N₂O 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 N₂O (a greenhouse gas) by installing of secondary DeN₂O 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 N₂O decomposition catalyst has been installed down stream of Pt gauze. The project activity helps in catalytic reduction of N₂O which is an undesirable by product of nitric acid production process and so emission reductions of it. N₂O 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 DeN₂O catalyst was installed and commissioned on 31.03.2010.

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, 30, 778 tCO₂/Campaign.

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°56'33" N
Longitude : 72°50'9" E

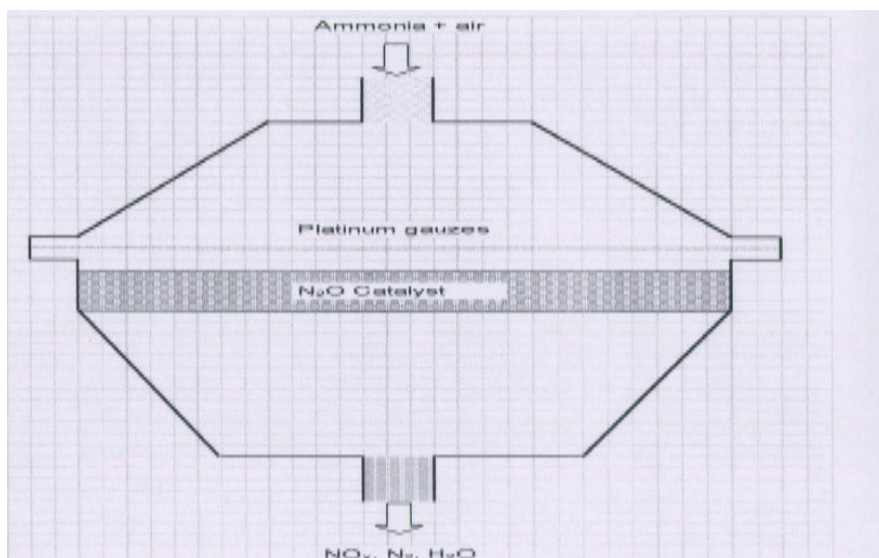
A.4. Technical description of the project

Nitric Acid (HNO₃) is produced through the oxidation of ammonia (NH₃) on precious metal catalyst gauze in the ammonia burner of a nitric acid plant. Nitrous Oxide (N₂O) is an undesirable by-product gas produced in the manufacture of nitric acid. Waste N₂O 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 N₂O 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 N₂O is reduced to harmless N₂. 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 N₂O. The reduction is done as below in an exothermic reaction.



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

- Approved baseline methodology AM0034 “Catalytic reduction of N₂O 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 12th February 2010 to 07th July 2010.

There was no exchange of equipment since installation of catalyst.

Shutdown details of equipment:

Please refer Annex1 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

The AM0034 Methodology requires project proponent to monitor Operating Hour (OH) of Nitric acid Plant during any project campaign.

As per the registered PDD, OH is required to be monitored as “Recorded at CEM system based on temperature limits of Reactor hours of daily operation”. However, PP for the period between 20/11/2009 to 09/07/2010 has used the data “Ammonia Flow to the Reactor” as the basis for monitoring OH.

RCF however have switched to the temperature limit of Reactor for monitoring of Operating Hours since 09.07.2010 which is in line with the registered PDD.

The above temporary change does not make any impact on emission reduction calculation.

B.4. Notification or request of approval of changes

NA

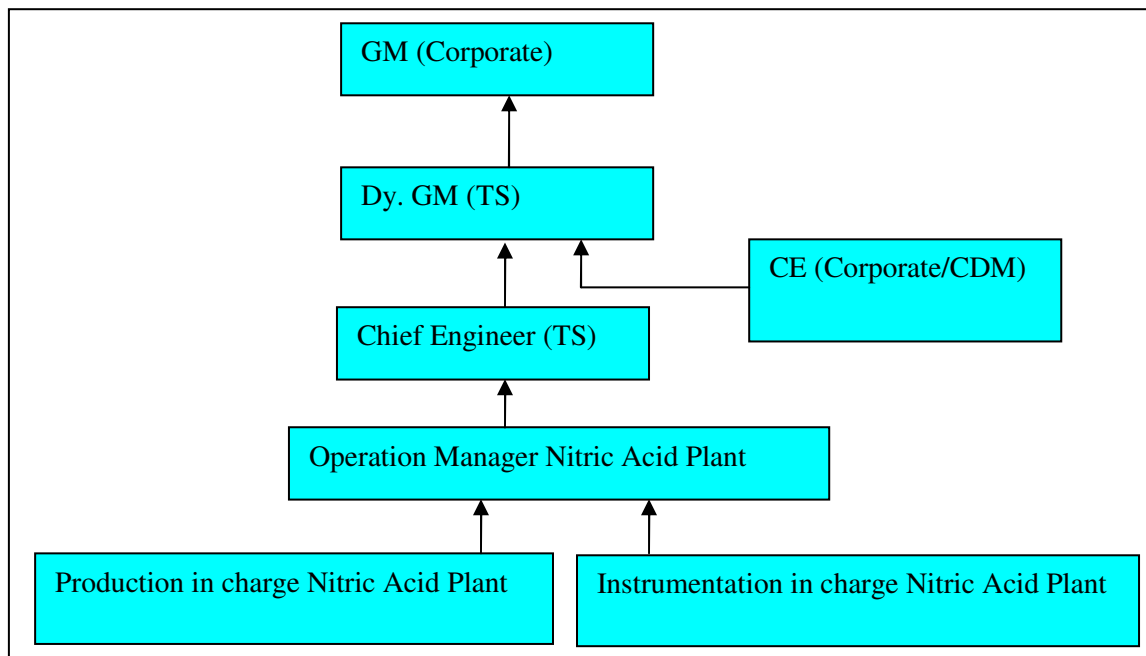
SECTION C. Description of the monitoring system

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. 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, 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.



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 N₂O 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 N₂O 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 N₂O 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 N₂O.

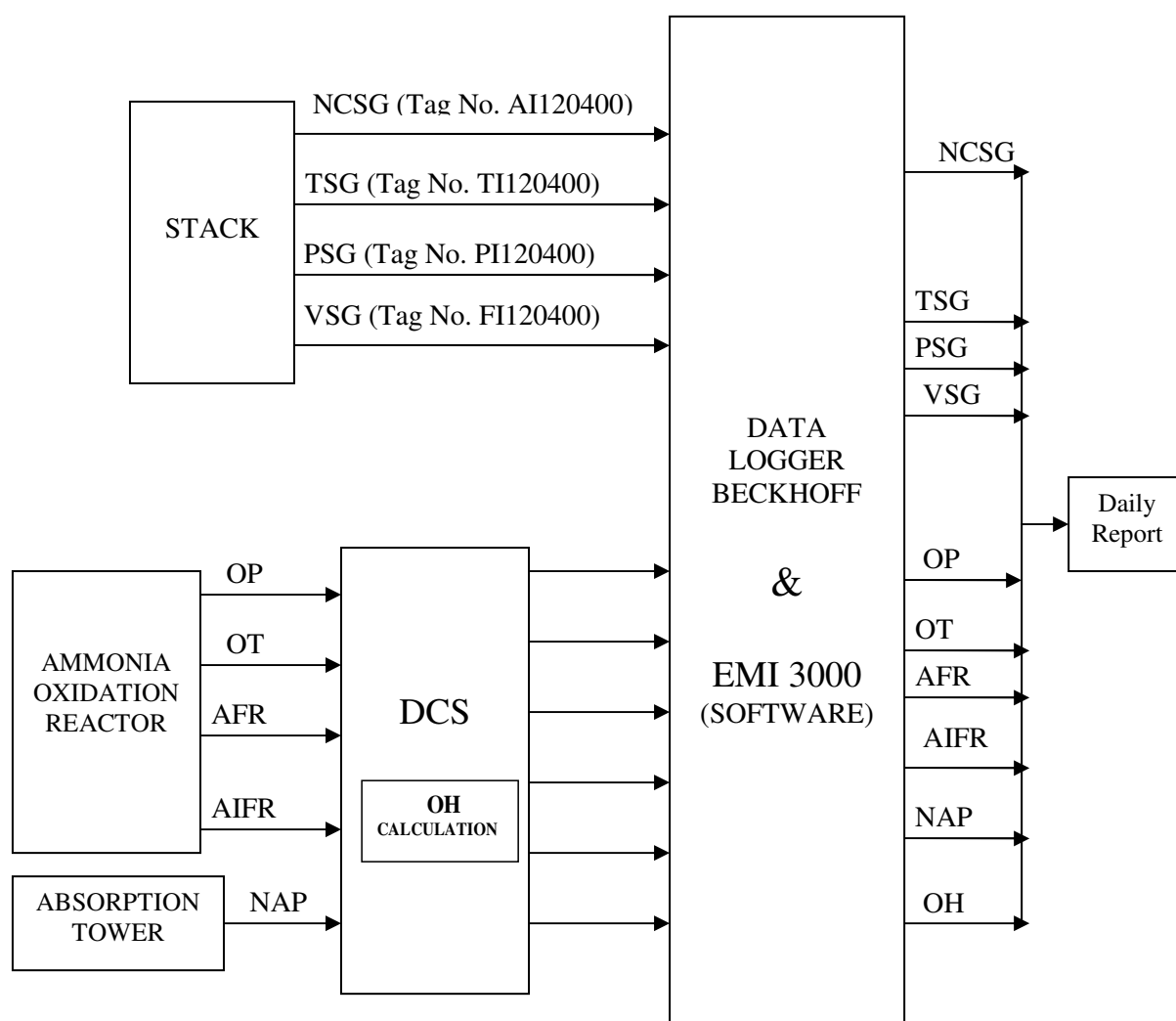
4. Sample Conditioning System

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 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 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

The maximum emissions possible during the crediting period, in case of emergency situation like complete deactivation of DeN₂O catalyst shall be same as that of base line emissions.

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 in case of emergency of breakdown of Automated monitoring system (AMS) RCF will follow the procedure mentioned in the methodology

Failure of Data Acquisition System	<p>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.</p> <p>In case, due to any reason data is not available due to failure of data recording following shall be considered -</p>
Failure of N ₂ O Analyzer (NCSG)	In case N ₂ O 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, 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)	<p>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.</p> <p>In case concentration of nitric acid has not been determine for the day due to any reasons like shutdown, start-up etc, then:</p> <ul style="list-style-type: none"> ➤ In case of shut down data for concentration shall be taken from previous day.



	<ul style="list-style-type: none"> ➤ 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:	Nm³/hr
Description:	Maximum Ammonia Flow Rate
Source of data used:	Plant Records
Value(s) :	6725 (This is equivalent to 5.113 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 = 900 Min = 863
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission/Project Campaign
Additional comment:	-

Data / Parameter:	OP_{normal}
Data unit:	Bar
Description:	Normal operating pressure
Source of data used:	Monitored
Value(s) :	Max = 6.60 (660 kPa) Min = 6.26 (626 kPa)
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission/Project Campaign
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.
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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:	mgN₂O/Nm³
Description:	N ₂ O Concentration in the stack gas
Source of data used:	N ₂ O analyser
Value(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the N ₂ O concentration values comes at 4054.1 mg N ₂ O/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 QAL 2 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:	Nm³/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 volume flow rate of the stack gas comes at 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 operating hours comes at 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:	tHNO₃
Description:	Nitric Acid (as 100%) over baseline campaign
Source of data used:	This is 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(s) :	For the baseline campaign run by RCF during 01/07/2008 and 07/11/2008, the nitric acid comes at 43326 tHNO ₃ .
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	<p>Nitric Acid Flow: Calibration of flow meter once in three years as per OEM Recommendation.</p> <p>Nitric Acid Concentration: Calibration of Hydrometer and Thermometer shall be ensured by ISO 9001 procedures.</p> <p>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.</p> <p>In case concentration of nitric acid has not been determined for the day due to any reason like shut down, start up etc, then;</p> <ul style="list-style-type: none"> • 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.



	<ul style="list-style-type: none"> 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 <p>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.</p>
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Data / Parameter:	CL_{BL}
Data unit:	tHNO₃
Description:	Length of Baseline Campaign
Source of data used:	As per the Production Data
Value(s) :	43326
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission
Additional comment:	-

Data / Parameter:	CL_{Normal}
Data unit:	tHNO₃
Description:	Normal Campaign Length
Source of data used:	Calculated from nitric acid production data
Value(s) :	44435
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline Emission/Project Campaign
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/Project Campaign
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}
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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/Project Campaign
Additional comment:	-

D.2. Data and parameters monitored

Data / Parameter:	NCSG
Data unit:	mgN ₂ O/Nm ³
Description:	N ₂ O concentration in the stack gas
Measured /Calculated /Default:	Measured
Source of data:	N ₂ O Analyser
Value(s) of monitored parameter:	942.59
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 II
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every two seconds
Description of measurement methods and procedures to be applied:	N ₂ O 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 accuracy of this instrument is 0.5%
Calculation method (if applicable):	-
QA/QC procedures applied:	N ₂ O 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 parameter:	49630.77
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 II
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 accuracy of this instrument is 0.04%.
Calculation method (if applicable):	-
QA/QC procedures applied:	Regular Calibrations according to ISO 9001 procedure 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:	2875
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 II
Measuring/ Reading/ Recording frequency:	Frequency of recording: Hourly compiled for entire campaign
Description of measurement methods and procedures to be applied:	-
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 <ol style="list-style-type: none"> 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(s) of monitored parameter:	44666.01
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 II
Measuring/ Reading/ Recording frequency:	Hourly Compiled for entire campaign
Description of measurement methods and procedures to be applied:	<p>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.</p> <p>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.</p> <p>In case concentration of nitric acid has not been determine for the day due to any reasons like shutdown, start-up etc, then:</p> <ul style="list-style-type: none"> • In case of shut down data for concentration shall be taken from



	<p>previous day.</p> <ul style="list-style-type: none"> • 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. <p>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 accuracy of this instrument is 0.1 %.</p>
Calculation method (if applicable):	-
QA/QC procedures applied:	<p>Nitric Acid Flow: Calibration of flow meter once in three years as per OEM recommendation.</p> <p>Nitric Acid Concentration: Calibration of Hydrometer and Thermometer shall be ensured by ISO 9001 Procedures.</p>

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 II
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every two seconds
Description of measurement methods and procedures to be applied:	Temperature transmitter coupled with Annubar (FI 120400) Tag no. TI 120400 (part of gas volume flow meter). The accuracy of this instrument is 0.1 %.



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 II
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 %.
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 number, calibration frequency, date of last	Given in Appendix II



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 0.1 %.
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 II
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 used for (Baseline/ Project/ Leakage emission)	Baseline/Project



calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix II
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 0.1%.
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)	Baseline/Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix II
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 0.15 %.
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
Description:	Oxidation pressure of each hour
Measured /Calculated /Default:	Measured
Source of data:	Continuous Emission Monitoring (CEM) system from ABB.



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Value(s) of monitored parameter:	Continuously monitored
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline/Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Given in Appendix II
Measuring/ Reading/ Recording frequency:	Frequency of monitoring: Every hour
Description of measurement methods and procedures to be applied:	Oxidation Pressure is measure by pressure transmitter tag no PT 120212A/B/C. The accuracy of this instrument is 0.075 %.
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 II
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:	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 ₂ O emissions
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline/Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not Applicable
Measuring/ Reading/ Recording frequency:	-
Description of measurement methods and procedures to	Currently there is no regulation for N ₂ O emission. The new regulation will get reflected in consent to operate the plants. Consent to operate



be applied:	will be checked for N ₂ O 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 tCO₂e/ tHNO₃

Particulars	Unit	Value
Volume flow rate of stack gas	Nm ³ /h	49077
N ₂ O concentration in stack gas - baseline	mg N ₂ O/ Nm ³	4054.10
Operating hours	h/campaign	2861
Baseline emissions	tN ₂ O/ campaign	569.23
Uncertainty UNC	%	4.52%
HNO ₃ production	tHNO ₃ / campaign	43326
N₂O emission factor – baseline	tN₂O/ tHNO₃	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.

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 N₂O 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 2:

No.	Description	Unit	Value
1	CL_n	tHNO ₃	44666.01
2	CL_{normal}	tHNO ₃	44435
3	CL_{BL}	tHNO ₃	43326

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

E.2. Project emissions calculation

Over the duration of the project activity, N₂O 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 (m³/h)

NCSG = Mean concentration of N₂O in the stack gas for the project campaign (mg N₂O/Nm³)

OH = is the number of hours of operation in the specific monitoring period (h)

PE_n = Total N₂O emissions of the nth project campaign (tN₂O)

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 N₂O 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	49630.77
NCSG	mgN ₂ O/ Nm ³	942.59
OH	Hours	2875
NAP	tHNO ₃	44666.01
PE n	tN ₂ O	134.50
EF 2	tN₂O/tHNO₃	0.0031

*Monitoring period start on 13th Feb 2010. It may be noted that 13th Feb will be defined from 12th Feb 2010 8 PM to 13th Feb 2010 11.59 PM This is because previous campaign ended on 12th Feb 2010 2 AM. The Plant remained shutdown for a period of 12th Feb 2010 2 AM to 12th Feb 2010 8 PM and the current campaign started on 12th Feb 2010 8 PM. Monitoring Period ended on Campaign ending on 7th June 00 Hrs.

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

$$EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n$$

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

Results:

Project Campaign 2:

As this is the first campaign in the project activity,



$$EF_1 = 0.0031$$

$$EF_2 = 0.0030$$

$$\begin{aligned}\text{Moving Average Emission Factor} &= EF_{ma, 2} = (EF_1 + EF_2) / 2 \\ &= (0.0031 + 0.0030) \\ &= 0.0031\end{aligned}$$

$$\begin{aligned}\text{EF for the Project} &= EF_p = \text{Max} (EF_{ma, n}, EF_3) \\ &= \text{Max} (0.0031, 0.0030) \\ &= 0.0031\end{aligned}$$

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:

$$ER = (EF_{BL} - EF_p) * NAP * GWP_{N_2O}$$

Where

- ER = Emission reductions of the project for the specific Monitoring period (tCO₂e)
 EF_{BL} = Baseline Emission Factor (tN₂O/tHNO₃)
 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 (tHNO₃). The Maximum Value of NAP shall not exceed the design capacity
 GWP_{N₂O} = Global Warming Potential for the N₂O as per IPCC default value.

Results:

Parameter	Unit	Values During Monitoring Period
NAP	tHNO ₃	44666.01
EF _{BL}	tN ₂ O/tHNO ₃	0.0125
EF _p	tN ₂ O/tHNO ₃	0.0031
GWP _{N₂O}	tCO ₂ /tN ₂ O	310

$$\begin{aligned}ER &= (0.0125 - 0.0031) * 44666.01 * 310 \\ &= 1,30,778 \text{ tCO}_2\end{aligned}$$

**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 ₂ e)	1,78,992	1,30,778

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

The emission reduction during this monitoring period is 1,30,778 tCO₂e which is less than the ex – ante value of 1,78,992 tCO₂e mainly due to lower than estimated catalyst efficiency. It may also be noted that plant was shutdown for a period approximately 27 days during monitoring period resulting in further lower emission reduction

**Annexure: 1****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	08.05.2010 20:00	12.05.2010 09:00	Power shutdown
2	24.05.2010 14:00	25.05.2010 10:00	Data Logger Problem
3	09.06.2010 18:00	10.06.2010 06:00	sample probe problem

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 Start up
1	-	12.02.2010 20:00 (Campaign Start-up)
2	03.03.2010 18:00	04.03.2010 22:00
3	23.03.2010 20:00	24.03.2010 20:00
4	26.03.2010 13:00	28.03.2010 11:00
5	06.04.2010 04:00	07.04.2010 13:00
6	06.05.2010 14:00	13.05.2010 19:00
7	29.05.2010 02:00	09.06.2010 16:00
8	17.06.2010 06:00	17.06.2010 20:00
9	07.07.2010 00:00 (Campaign End)	-

Appendix: ITechnical 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 N001	Nm3/Hr	D.P Type Transmitter	FT120 211A	S198744	17/08/2009	06/08/2010	1 Year	06/08/2011
AFR	Amm gas to N001	Nm3/Hr	D.P Type Transmitter	FT120 211B	S198745	17/08/2009	06/08/2010	1 Year	06/08/2011
AFR	Amm gas to N001	Nm3/Hr	D.P Type Transmitter	FT120 211C	S198746	19/08/2009	06/08/2010	1 Year	06/08/2011
OP	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212A	1209936	19/08/2009	04/08/2010	1 Year	04/08/2011
OP	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212B	1209934	19/08/2009	04/08/2010	1 Year	04/08/2011
OP	Amm - inlet to N001	Barg	Pressure Transmitter	PT 120212C	1209937	19/08/2009	04/08/2010	1 Year	04/08/2011
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212A	NA	19/08/2009	02/08/2010	1 Year	02/08/2011
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212B	NA	17/08/2009	02/08/2010	1 Year	02/08/2011
NA	Amm - inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120212C	NA	17/08/2009	02/08/2010	1 Year	02/08/2011
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213A	S198740	17/08/2009	06/08/2010	1 Year	06/08/2011
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213B	S198741	17/08/2009	06/08/2010	1 Year	06/08/2011
NA	Air Flow-N001	Nm3/Hr	D.P Type Transmitter	FT 120213C	S198742	19/08/2009	06/08/2010	1 Year	06/08/2011
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214A	S0198760	17/08/2009	05/08/2010	1 Year	05/08/2011
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214B	S0198761	19/08/2009	05/08/2010	1 Year	05/08/2011
NA	Air inlet to N001	Barg	Pressure Transmitter	PT120 214C	S0198762	19/08/2009	05/08/2010	1 Year	05/08/2011
NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214A	NA	17/08/2009	04/08/2010	1 Year	04/08/2011
NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214B	NA	19/08/2009	04/08/2010	1 Year	04/08/2011
NA	Air inlet to N001 temp	Deg.cent	RTD with R/I converter	TT 120214C	NA	19/08/2009	04/08/2010	1 Year	04/08/2011
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT12033 2A	199556	18/08/2009	02/08/2010	1 Year	02/08/2011
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT12033 3A	199558	18/08/2009	02/08/2010	1 Year	02/08/2011
OT	Catalyst Temp ROO1	Deg.cent	Temp. Transmitter	TT12033 4A	199560	18/08/2009	02/08/2010	1 Year	02/08/2011
NCS G	N2O Analyser	Mg/m3	N2O Analyser	AI 120400	02400712 28/2400	28/05/2010	28/08/2010	3 Months	25/11/2010
VSG	Stack Flow	mBar	D.P Type Transmitter	FI120400	265DS660 0028331	06/07/2009	08/07/2010	1Year	08/07/2011
PSG	Stack Pressure	hPa	Pressure Transmitter	PI120400	1198949	06/07/2009	08/07/2010	1Year	08/07/2011
TSG	Stack Temp	Deg.cent	RTD with R/I	TI120400	NA	06/07/2009	08/07/2010	1Year	08/07/2011



			converter						
NAP	Product acid flow	T/hr	Mass flow meter	F110121	SEN.- 12031565, TRANS.- 3781972	24/06/2008		3 Years	24/06/2011
NA	Acid Density	gm/cc	Hydrometer	NA	NA	30/11/2009	28/05/2010	6 months	27/11/2010
NA.	Acid Temperature	Deg C	Thermometer	NAG/L/T M-1	NA	25/11/2009	25/11/2009	1 Year	25/11/2010