

CDM Monitoring Report N°3
Version 01
25 March, 2010

**“Sasol Nitrous Oxide Abatement Project”
South Africa**

UNFCCC Ref N° 0961

Monitoring period
From: August 10nd 2008
To: August 3th 2009

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1. Introduction

The purpose of this monitoring report is to provide information about GHG emission reduction achieved due to the project activity.

This monitoring report involves project activity from: August 10, 2008 to August 3, 2009 (both days included). The abovementioned period splits as follows:

Sasolburg plant:

- Third project campaign- from August 10, 2008 to Dec 8, 2008
- Fourth project campaign- from December 11, 2008 to August 3, 2009

Secunda plant:

- Third project campaign- from August 31, 2008 to April 26, 2009.
- Fourth project campaign- from May 2, 2009 to August 3, 2009.

Duration of the project activity period:

Registration date: May 25, 2007

Crediting period: May 25, 2007 to May 24, 2014 (renewable)

Sasol Nitro has implemented a project activity aimed to reduce N₂O emissions at its nitric acid plants, Sasolburg and Secunda.

The project activity is under the category large scale, sectoral scope 5 “Chemical Industry”.

2. Reference

Approved baseline methodology

AM0034 version 2 “Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants”

Approved monitoring methodology

AM0034 version 2 “Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants”

Project Design Document

“Sasol Nitrous Oxide Abatement Project”. Version 5, January 31, 2007.

Validation Report

“Sasol Nitrous Oxide Abatement Project” in South Africa.

Report N° 2007-0195

Date: February 7, 2007

CDM Registration

“Sasol Nitrous Oxide Abatement Project”.Ref. N° 0961.

Date of registration: May 25, 2007.

3. Description of the Project Activity

The project activity involves the installation of a secondary catalyst to abate N₂O inside the ammonia burner once it is formed.

Nitrous oxide (N₂O) is an undesired by-product gas from the manufacture of nitric acid. Nitrous oxide is formed during the catalytic oxidation of ammonia. Over a suitable catalyst, a maximum 98% (typically 92-96%) of the ammonia fed is converted to nitric oxide (NO). The remainder participates in undesirable side reactions that lead to the production of nitrous oxide, among other compounds.

Waste N₂O from nitric acid production is typically released into the atmosphere, as it does not have any economic value or toxicity at typical emission levels. N₂O is an important greenhouse gas which has a high global warming potential (GWP) of 310.

The current project activity takes place at two nitric acid plants owned by Sasol Nitro, Sasolburg and Secunda.

4. Project Participants

Name of Party involved	Project participant (as applicable)	Party involved considered as project participant
United Kingdom	MGM Carbon Portfolio	No
Republic of South Africa (host)	Sasol Nitro, a division of Sasol Chemical Industries Limited. Private entity. Project Developer.	No

Sasol Nitro (hereinafter called “Sasol”) is a division of Sasol Chemical Industries Limited, a private company incorporated under the laws of the Republic of South Africa. Sasol Chemical Industries Limited is part of the Sasol group of companies (the Sasol Group) whose activities are coordinated by the holding company Sasol Limited, founded in 1950. The Sasol Group is an integrated oil and gas entity with substantial chemical interests. It is based in South Africa with its head office in Johannesburg, but also has manufacturing and marketing facilities elsewhere in Africa, Europe, Asia and the Americas. Sasol is listed on the Johannesburg Securities Exchange (JSE), symbol SOL, and the New York Stock Exchange (NYSE), symbol SSL. Sasol Chemical Industries Limited represents the Sasol Group’s chemical businesses with its portfolio including polymers, solvents, olefins, surfactants, waxes, phenolics and nitrogenous products. Sasol Nitro, a division of Sasol Chemical Industries Limited, represents the nitrogenous products and related goods; it manufactures and markets ammonia, nitric acid, fertilizers, phosphoric acid, a phosphoric detergent, commercial explosives and specialized blasting accessories. The division also markets ammonia, sulfur and specialty gases produced by other Sasol divisions. Sasol Nitro operates two nitric acid plants. The smaller 557 tonne 100% nitric acid per day unit in Sasolburg is linked to a downstream ammonium nitrate plant. The ammonium nitrate is processed in Sasolburg to produce low-density ammonium nitrate for use in the production of commercial explosives. The larger 860 tonne per day unit in Secunda supplies a downstream ammonium nitrate plant linked to a 500,000 tonne per annum fertilizer granulation facility that produces limestone ammonium nitrate (LAN) and various other fertilizer grades containing nitrogen, phosphorus and potassium. Ammonium nitrate for industrial use is sourced from both sites.

5. Project Location

The project activity is located at two nitric acid plants owned by Sasol. Sasolburg plant is located at Sasolburg city, Free State; and Secunda plant is located at Secunda city, Mpumalanga.

6. Project Boundary

The project boundary encompasses the physical, geographical site of Sasolburg and Secunda nitric acid plants and equipment for the complete nitric acid production process from the inlet to the ammonia burner to the stack.

The only GHG emission relevant to the project activity is N₂O contained in the waste stream exiting the stack at each site. The abatement of N₂O is the only GHG emission under the control of the project participant.

	Source	Gas	Included?	Justification/Explanation
Baseline	Nitric Acid Plant (Burner Inlet to Stack)	CO ₂	Excluded	The project does not lead to any change in CO ₂ or CH ₄ emissions, and, therefore, these are not included.
		CH ₄	Excluded	
		N ₂ O	Included	
Project Activity	Nitric Acid Plant (Burner Inlet to Stack)	CO ₂	Excluded	The project does not lead to any change in CO ₂ or CH ₄ emissions.
		CH ₄	Excluded	
		N ₂ O	Included	
	Leakage emissions from production, transport, operation and decommissioning of the catalyst	CO ₂	Excluded	No leakage emissions are expected.
		CH ₄	Excluded	
		N ₂ O	Excluded	

The figures below show the project boundaries for Sasolburg and Secunda plants.

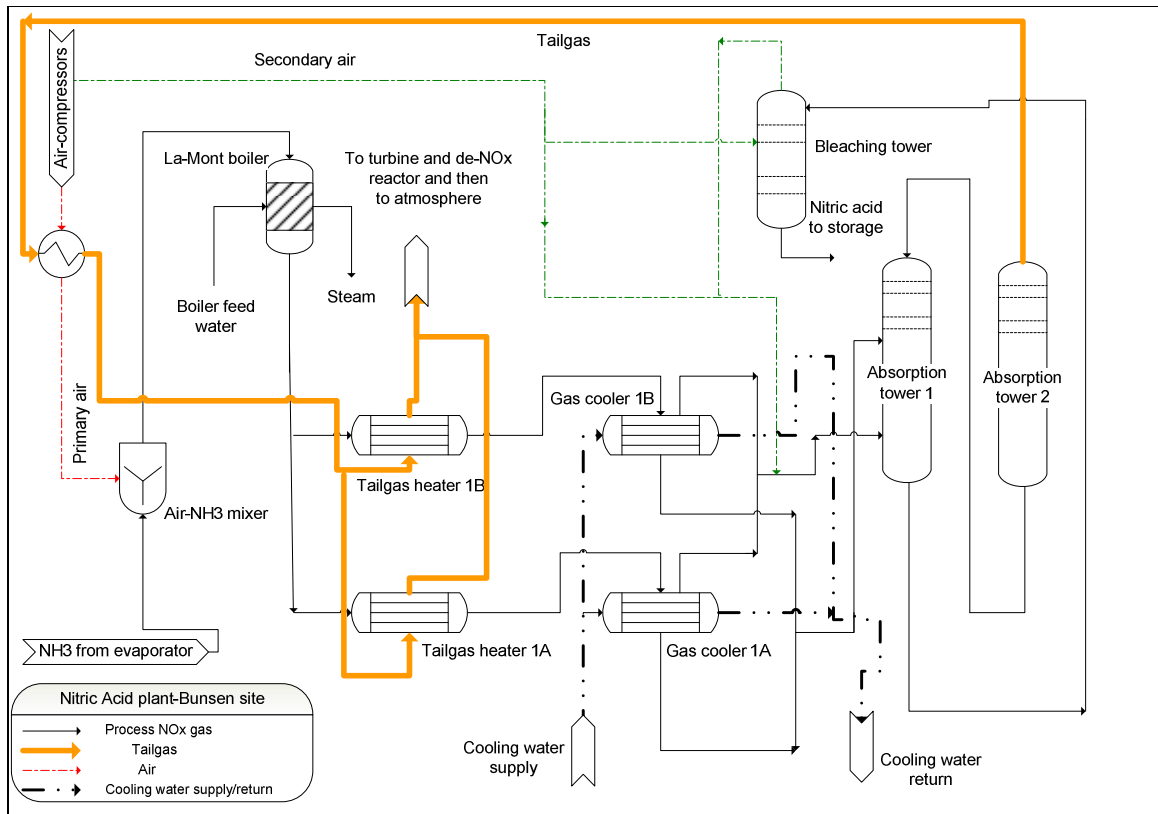


Figure 1. Project boundary for Sasolburg nitric acid plant

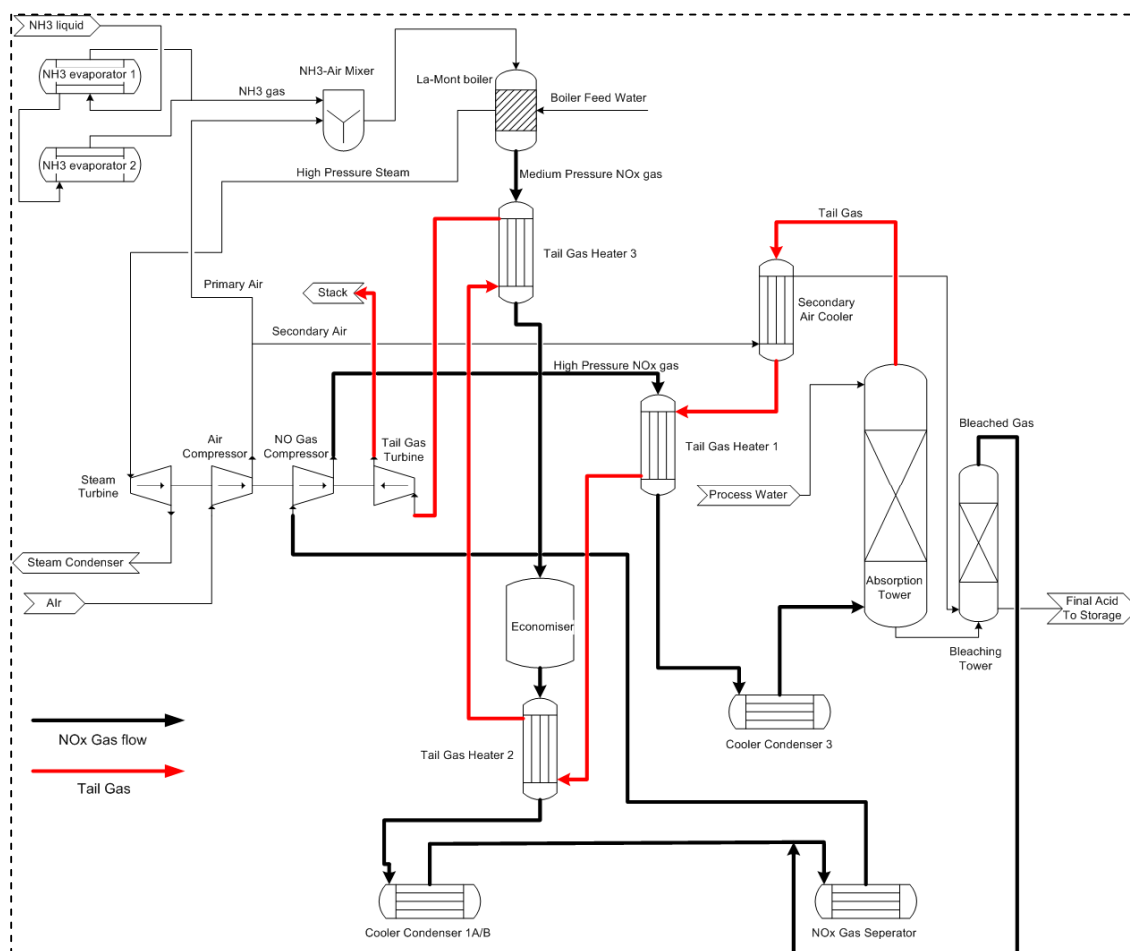


Figure 2. Project boundary for Secunda nitric acid plant

7. Monitoring Methodology and Plan

7.1. Data Monitored

The following tables show the parameters that have been monitored in order to calculate baseline emission factors.

Data / Parameter:	Baseline Volume Flow in the Stack Gas, VSG_{BC}
Data unit:	Nm^3 / hour (wet basis)
Description:	Mean gas volume flow rate in the stack gas during baseline campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: $71,377 Nm^3/h$ Secunda: $116,409 Nm^3/h$
Recording frequency	Every two seconds
Comments:	None



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Data / Parameter:	Baseline Temperature of the Stack Gas, TSG_{BC}
Data unit:	°C
Description:	Temperature of the gas in the stack gas during baseline campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 214.2°C Secunda: 95.5 °C
Recording frequency	Every two seconds
Comments	Average value

Data / Parameter:	Baseline Pressure of the Stack Gas, PSG_{BC}
Data unit:	bar
Description:	Pressure in the stack gas during baseline campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 0.841 bar Secunda: 0.868 bar
Recording frequency	Every two seconds
Comments:	Average value

Data / Parameter:	Baseline N₂O Concentration in the Stack Gas, NCSG_{BC}
Data unit:	mg N ₂ O/ m ³ (converted from ppmv if necessary) (wet basis)
Description:	Mean concentration of N ₂ O in the stack gas for the baseline campaign
Source of data to be used:	AMS (infrared gas analyzer) of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 3,085 mg N ₂ O/ Nm ³ Secunda: 1,474 mg N ₂ O/ Nm ³
Recording frequency	Every two seconds
Comments:	Value applied for Third project campaign at Secunda plant: 1,446 mg N ₂ O/ Nm ³

Data / Parameter:	Baseline Operating Hours, OH_{BC}
Data unit:	Hour
Description:	Total operating hours for the baseline campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 5,940 hours Secunda: 4,810 hours
Recording frequency	Once a day
Comments:	None

Data / Parameter:	Uncertainty of the Monitoring System, UNC
Data unit:	%
Description:	Overall uncertainty of the monitoring system, calculated as the combined uncertainty of the applied monitoring equipment
Source of data to be used:	Measured by QAL2 test.



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Value of data monitored	For Sasolburg: 3.89% For Secunda: 4.14%
Recording frequency	Calculated once
Comments:	Data obtained from QAL2 test carried out by SGS

Data / Parameter:	Nitric Acid Production, NAP_{BC}
Data unit:	tonne 100% HNO_3
Description:	Total nitric acid production for the baseline campaign.
Source of data to be used:	Production logs of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 130,069 tonne 100% HNO_3 Secunda: 172, 879 tonne 100% HNO_3
Recording frequency	Daily
Comment:	Baseline campaign at Sasolburg plant exceeded normal campaign length, which was 114,727 tonne 100% HNO_3 . Then, the baseline emission factor was calculated accordingly.

Data / Parameter:	Total N_2O for baseline campaign, BE_{BC}
Data unit:	tonne N_2O
Description:	Total N_2O for the baseline campaign.
Source of data to be used:	Calculated from monitored data.
Value of data monitored	Sasolburg: 1,307.8 tonne N_2O Secunda: 825.3 tonne N_2O Value applied for third project campaign: Secunda: 809.78 tonne N_2O
Recording frequency	Calculated once at the end of the baseline campaign
Comment:	Third project campaign at Secunda plant was shorter than normal campaign length. Hence, BE_{BC} used to recalculate EF_{BL} for third project campaign includes N_2O monitored values up to the previous day in which the plant exceeded the third project campaign length.

Data / Parameter:	Baseline Emission Factor, EF_{BL}
Data unit:	ton N_2O / ton 100% HNO_3
Description:	Baseline emission factor is calculated from monitored data for the baseline campaign
Source of data to be used:	Calculated from monitored data.
Value of data monitored	Sasolburg: 0.00966 tonne N_2O / tonne 100% HNO_3 . Secunda: 0.00457 tonne N_2O / tonne 100% HNO_3 . Baseline emission factor for third project campaign at Secunda plant was recalculated according to project campaign length. Value applied is: 0.00449 tonne N_2O / tonne 100% HNO_3 .
Recording frequency	Calculated once at the end of the baseline campaign
Comments:	At Sasolburg plant baseline campaign length was 130,069 tonne 100% HNO_3 , this production exceeds normal campaign length, 114,727 tonne 100% HNO_3 . Hence for baseline emission factor calculation, values of $NCSG_{BC}$ previous to the day in which the plant exceeded the normal campaign length were used.



	(February 3 rd 2007).
	At Secunda plant third project campaign length was 157,498 tonne 100% HNO ₃ , shorter than normal campaign length (183,602 tonne %HNO ₃). Then we recalculated the baseline emission factor that applied for the third project campaign using values of NCSG _{BC} previous to the day in which the plant exceeded the third project campaign length. (March 4 th , 2007).

Data / Parameter:	Baseline Oxidation Temperature, OT_{BC}
Data unit:	°C
Description:	Oxidation temperature of the ammonia reactor for the baseline campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 878°C Secunda: 870°C
Recording frequency	Every hour
Comments:	Average value

Data / Parameter:	Baseline Oxidation Pressure, OP_{BC}
Data unit:	bar
Description:	Oxidation pressure of the ammonia reactor for the baseline campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 4.0 bar Secunda: 4.7 bar
Recording frequency	Every hour
Comments:	Average value

Data / Parameter:	Baseline Ammonia Flow Rate, AFR_{BC}
Data unit:	kg NH ₃ /hour
Description:	Ammonia flow rate to the ammonia oxidation reactor for the baseline campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 5,904 kg NH ₃ /hour Secunda: 9,187 kg NH ₃ /hour
Recording frequency	Continuously
Comments:	Average value

Data / Parameter:	Baseline Ammonia to Air Flow Rate, AIFR_{BC}
Data unit:	kg NH ₃ /kg air
Description:	Ammonia to air flow rate to the ammonia oxidation reactor for the baseline campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 0.061 kg NH ₃ /kg air Secunda: 0.061 kg NH ₃ /kg air
Recording frequency	Every hour
Comments:	Average value



Data / Parameter:	Baseline Campaign Length, CL_{BL}
Data unit:	tonne 100% HNO_3
Description:	Campaign length is defined as the total number of metric tonnes of nitric acid at 100% concentration produced with one set of gauzes. (see baseline nitric acid production, NAP_{BC})
Source of data to be used:	Plant production log book
Value of data monitored	Sasolburg: 130,069 tonne 100% HNO_3 Secunda: 172, 879 tonne 100% HNO_3
Recording frequency	Daily
Comments:	Baseline campaign at Sasolburg plant exceeded normal campaign length, which was 114,727 tonne 100% HNO_3 . Then, the baseline emission factor was calculated accordingly.

Data / Parameter:	Baseline Gauze Supplier GS_{BC}
Data unit:	Company name
Description:	Gauze supplier for the baseline campaign
Source of data to be used:	Procurement offices of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: W.C. Heraeus Secunda: W.C. Heraeus
Recording frequency	Once
Comments:	None

Data / Parameter:	Baseline Gauze Composition, GC_{BC}
Data unit:	%(Pt, Rh, Pd)
Description:	Gauze composition for the baseline campaign
Source of data to be used:	Nitric acid plant procurement office and gauze Supplier technical service department
Value of data monitored	Sasolburg: Pt 54.0 to 56.0 %, Rh 3.6 to 3.9 %, Pd 40.0 to 42.0%. Secunda: Pt 54.0 to 55.0 %, Rh 3.5 to 3.8 %, Pd 41.0 to 43.0 %
Recording frequency	Once
Comments:	None.

The following tables show the parameters monitored in order to calculate project emissions.

Third project campaign

Data / Parameter:	Project Volume Flow in the Stack Gas, $VSG_{project}$
Data unit:	Nm^3 / hour (wet basis)
Description:	Mean volume flow rate in the stack gas for the project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 71,360 Nm^3 / hour Secunda: 107,922 Nm^3 / hour
Recording frequency	Every two seconds



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Comments:	None
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Data / Parameter:	Project Temperature of the Stack Gas, TSG_{project}
Data unit:	°C
Description:	Temperature of the gas in the stack gas during project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 224°C Secunda: 99°C
Recording frequency	Every two seconds
Comments:	Average value

Data / Parameter:	Project Pressure of the Stack Gas, PSG_{project}
Data unit:	bar
Description:	Pressure in the stack gas for the project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 0.851 bar Secunda: 0.869 bar
Recording frequency	Every two seconds
Comments:	Average value

Data / Parameter:	Project N₂O Concentration in the Stack Gas, NCSG_{project}
Data unit:	mg N ₂ O/ Nm ³ (converted from ppmv if necessary) (wet basis)
Description:	Mean N ₂ O concentration in the stack gas for the project campaign
Source of data to be used:	AMS (infrared gas analyzer) at Sasolburg and Secunda plants.
Value of data monitored	Sasolburg: 774 mg N ₂ O/ Nm ³ Secunda: 1243 mg N ₂ O/ Nm ³
Recording frequency	Every two seconds
Comments:	None.

Data / Parameter:	Project Operating Hours, OH_{project}
Data unit:	Hour
Description:	Total operating hours for the project campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 5,394 hours Secunda: 4,841 hours
Recording frequency	Daily
Comments:	None

Data / Parameter:	Project Nitric Acid Production, NAP_{project}
Data unit:	tonne 100% HNO ₃
Description:	Total nitric acid production for the project campaign
Source of data to be	Production logs of Sasolburg and Secunda plants



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used:	
Value of data monitored	Sasolburg: 121,814 tonne 100% HNO ₃ Secunda: 157,498 tonne 100% HNO ₃
Recording frequency	Daily
Comments:	Nitric acid production during the third project campaign at Sasolburg plant was 121,814 tonnes HNO ₃ Production for the monitoring period was 63,848 tonne 100% HNO ₃

Data / Parameter:	N₂O emissions of nth project campaign, PE_n
Data unit:	tonne N ₂ O
Description:	N ₂ O emissions of 3 rd project campaign.
Source of data to be used:	Calculated from monitored data.
Value of data monitored	Sasolburg: 297.88 tonne N ₂ O Secunda: 649.68 tonne N ₂ O
Recording frequency	Calculated once at the end of the third project campaign.
Comment:	None

Data / Parameter:	Project Emission Factor, EF_n
Data unit:	tonne N ₂ O / tonne 100% HNO ₃
Description:	Project emission factor calculated from monitored data for the project campaign
Source of data to be used:	Calculated from monitoring data
Value of data monitored	Sasolburg: 0.00245 tonne N ₂ O / tonne 100% HNO ₃ . Secunda: 0.00412 tonne N ₂ O / tonne 100% HNO ₃ .
Recording frequency	Calculated once after ending the project campaign
Comments:	None

Data / Parameter:	Moving Average Emission factor, EF_{ma,n}
Data unit:	tonne N ₂ O / tonne 100% HNO ₃
Description:	Moving average of emission factor calculated as the average of the emission factors of all previous project campaigns
Source of data to be used:	Calculated from campaign emission factors
Value of data monitored	Sasolburg: 0.001815 tonne N ₂ O / tonne 100% HNO ₃ . Secunda: 0.00314 tonne N ₂ O / tonne 100% HNO ₃
Recording frequency	Calculated at the end of each project campaign
Comments:	None

Data / Parameter:	Emission factor used to determine emission reductions, EF_p
Data unit:	tonne N ₂ O / tonne 100% HNO ₃
Description:	Emission factor used to calculate the emission from the particular campaign.
Source of data to be used:	Calculated using campaign emission factors. EF _p will be determined as the higher of EF _{ma,n} and EF _n .
Value of data monitored	Sasolburg: 0.00245 tonne N ₂ O / tonne 100% HNO ₃ . Secunda: 0.00412 tonne N ₂ O / tonne 100% HNO ₃
Recording frequency	Calculated at the end of each project campaign



Comments:	None
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Data / Parameter:	Project Campaign Length, CL_n
Data unit:	tonne 100% HNO_3
Description:	The project campaign length for the nth campaign (CL_n) is defined as the nitric acid produced during the nth campaign (see project nitric acid production)
Source of data to be used:	Sasolburg and Secunda production log books.
Value of data monitored	Sasolburg: 121,814 tonnes HNO_3 Secunda: 157,498 tonnes HNO_3
Recording frequency	Calculated at the end of the project campaign
Comments:	None

Data / Parameter:	Project Gauze Supplier, GS_n
Data unit:	Company name
Description:	Gauze supplier for the project campaign
Source of data to be used:	Procurement offices of Sasolburg and Secunda Plants
Value of data monitored	Sasolburg: W.C. Heraeus Secunda: W.C. Heraeus
Recording frequency	Once
Comments:	None

Data / Parameter:	Project Gauze Composition, GC_n
Data unit:	% (Pt, Rh, Pd)
Description:	Gauze concentration for the project campaign
Source of data to be used:	Procurement offices of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: Pt 54.0 to 56.0 %, Rh 3.6 to 3.9 %, Pd 40.0 to 42.0%. Secunda: Pt 54.0 to 55.0 %, Rh 3.5 to 3.8 %, Pd 41.0 to 43.0 %
Recording frequency	Once
Comments:	None

Data / Parameter:	Emission Factor set by regulation, EF_{reg}
Data unit:	kg N_2O / tonne HNO_3
Description:	Local and national regulations on N_2O and NO_x emissions
Source of data to be used:	Local and national regulations
Value of data monitored	No local or national regulation has been introducing during project period.
Recording frequency	At date of introducing or change of regulation.
Comments:	

Fourth project campaign



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Data / Parameter:	Project Volume Flow in the Stack Gas, $VSG_{project}$
Data unit:	Nm^3 / hour (wet basis)
Description:	Mean volume flow rate in the stack gas for the project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 72,180 Nm^3 / hour Secunda: 113,387 Nm^3 / hour
Recording frequency	Every two seconds
Comments:	None

Data / Parameter:	Project Temperature of the Stack Gas, $TSG_{project}$
Data unit:	°C
Description:	Temperature of the gas in the stack gas during project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 222 °C Secunda: 96 °C
Recording frequency	Every two seconds
Comments:	Average value

Data / Parameter:	Project Pressure of the Stack Gas, $PSG_{project}$
Data unit:	bar
Description:	Pressure in the stack gas for the project campaign
Source of data to be used:	AMS (flow meter) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 0.860 bar Secunda: 0.868 bar
Recording frequency	Every two seconds
Comments:	Average value

Data / Parameter:	Project N_2O Concentration in the Stack Gas, $NCSG_{project}$
Data unit:	mg N_2O / m^3 (converted from ppmv if necessary) (wet basis)
Description:	Mean N_2O concentration in the stack gas for the project campaign
Source of data to be used:	AMS (infrared gas analyzer) at Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 135 mg N_2O / m^3 Secunda: 987 mg N_2O / m^3
Recording frequency	Every two seconds
Comments:	None

Data / Parameter:	Project Operating Hours, $OH_{project}$
Data unit:	Hour
Description:	Total operating hours for the project campaign
Source of data to be used:	Process control system of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: 5,606 hours Secunda: 5,566 hours



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Recording frequency	Daily
Comments:	None

Data / Parameter:	Project Nitric Acid Production, $NAP_{project}$
Data unit:	tonne 100% HNO_3
Description:	Total nitric acid production for the project campaign
Source of data to be used:	Production logs of Sasolburg and Secunda plants.
Value of data monitored	Sasolburg: 122,293 tonne 100% HNO_3 Secunda: 195,249 tonne 100% HNO_3
Recording frequency	Daily
Comments:	Nitric acid production during the fourth project campaign at Secunda plant was 195,249 tonne HNO_3 Production for the monitoring period was 53,204 tonne 100% HNO_3

Data / Parameter:	N_2O emissions of nth project campaign, PE_n
Data unit:	tonne N_2O
Description:	N_2O emissions of 4 th project campaign.
Source of data to be used:	Calculated from monitored data.
Value of data monitored	Sasolburg: 54.66 tonne N_2O Secunda: 623.16 tonne N_2O
Recording frequency	Calculated once at the end of the fourth project campaign.
Comment:	None

Data / Parameter:	Project Emission Factor, EF_n
Data unit:	tonne N_2O / tonne 100% HNO_3
Description:	Project emission factor calculated from monitored data for the project campaign
Source of data to be used:	Calculated from monitoring data
Value of data monitored	Sasolburg: 0.00045 tonne N_2O / tonne 100% HNO_3 . Secunda: tonne 0.00319 tonne N_2O / tonne 100% HNO_3 .
Recording frequency	Calculated once after ending the project campaign
Comments:	None

Data / Parameter:	Moving Average Emission factor, $EF_{ma,n}$
Data unit:	tonne N_2O / tonne 100% HNO_3
Description:	Moving average of emission factor calculated as the average of the emission factors of all previous project campaigns
Source of data to be used:	Calculated from campaign emission factors
Value of data monitored	Sasolburg: 0.000815 tonne N_2O / tonne 100% HNO_3 . Secunda: 0.00267 tonne N_2O / tonne 100% HNO_3
Recording frequency	Calculated at the end of each project campaign
Comments:	None



Data / Parameter:	Project Campaign Length, CL_n
Data unit:	tonne 100% HNO_3
Description:	The project campaign length for the nth campaign (CL_n) is defined as the nitric acid produced during the nth campaign (see project Nitric Acid Production)
Source of data to be used:	Sasolburg and Secunda production log books.
Value of data monitored	Sasolburg: 122,293 tonne 100% HNO_3 Secunda: 195,249 tonne 100% HNO_3
Recording frequency	Calculated at the end of the project campaign
Comments:	None.

Data / Parameter:	Project Gauze Supplier, GS_n
Data unit:	Company name
Description:	Gauze supplier for the project campaign
Source of data to be used:	Procurement offices of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: W.C. Heraeus Secunda: W.C. Heraeus
Recording frequency	Once
Comments:	None

Data / Parameter:	Project Gauze Composition, GC_n
Data unit:	% (Pt, Rh, Pd)
Description:	Gauze concentration for the project campaign
Source of data to be used:	Procurement offices of Sasolburg and Secunda plants
Value of data monitored	Sasolburg: Pt 54.0 to 56.0 %, Rh 3.6 to 3.9 %, Pd 40.0 to 42.0%. Secunda: Pt 54.0 to 55.0 %, Rh 3.5 to 3.8 %, Pd 41.0 to 43.0 %
Recording frequency	Once
Comments:	None

Data / Parameter:	Emission Factor set by regulation, EF_{reg}
Data unit:	kg N_2O / tonne HNO_3
Description:	Local and national regulations on N_2O and NO_x emissions
Source of data to be used:	Local and national regulations
Value of data monitored	No local or national regulation has been introducing during project period
Recording frequency	At date of introducing or change of regulation
Comments:	



At each plant process data and data from the AMS are acquired by the DSC system. MGM receives all the information given by the plants and elaborates the emission factors and emission reduction calculations.

7.2. Good monitoring practice and performance characteristics

The European Norm EN 14181:2004 is recommended as guidance regarding the selection, installation and operation of the AMS under Monitoring Methodology AM0034, and stipulates three quality assurance levels (QALs):

QAL1: Suitability of the AMS for the specific measuring task

The EN 14181: 2004 QAL1 reports were provided by the equipment manufacturers considering the performance characteristics as measured by a qualified technical inspection authority (such as the German TÜV) and the specific installation characteristics and site conditions at each plant. The QAL1 reports confirmed that the N₂O analyzers (in both cases an AO 2000- URAS 14 NDIR supplied by ABB GmbH) are suitable for performing the indicated analysis (N₂O concentration). Reports were audited during validation and are available at the sites for future audits.

QAL2: Validation of the AMS following its installation

QAL2 describes a procedure for the determination of the calibration function and its variability, by means of a certain number of parallel measurements, performed with a standard reference method. The testing laboratory performing the measurements with the standard reference method shall have an accredited quality assurance system according to EN ISO/IEC 17025 or relevant (national) standards.

QAL2 tests were performed in February 2007, at both plants by SGS Environmental Services (ISO 17025 certified lab). The QAL2 reports are available for DOE review. The reports conclude that the monitoring systems at both plants comply with QAL1 and QAL2 demands of EN 14181.

In order to keep records of AMS data before and after QAL2 test as generated (unmanipulated data), the corrective formulae (calibration functions) were applied during data processing (with the aid of spreadsheets), meaning that calibration functions were not programmed on the distributed control system (DCS) of the plants (which function as data acquisition systems).

QAL3: Ongoing quality assurance during operation

QAL3 of EN 14181: 2004 checks for drift and precision, in order to demonstrate that the AMS is in control during its operations so that it continues to function within the required specification for uncertainty. This is achieved by conducting periodic zero and span checks on the AMS, and evaluating results obtained using control charts. Results of periodic calibrations were analyzed graphically with the aid of Shewart charts. All monitoring equipment has been serviced and maintained according to the manufacturer's instructions and international standards by qualified personnel. Calibration and maintenance records are well kept at both Sasol plants and available for auditing purposes.

AST: annual surveillance test (AST)

The AST is a procedure to evaluate whether the measured values obtained from the AMS still meet the required uncertainty criteria, as evaluated during the QAL2 test. Just as with the QAL2, it also requires a limited number of parallel measurements using an appropriate standard reference method.

An AST was performed by SGS Environmental Services (ISO 17025 certified lab) at both plants in August 2008. The AST report is available for DOE review. The report concludes the following: The QA/QC system at both plants complies with the requirements of EN 14181 QAL3; all the analyzers passed the test of variance, suitability and linearity; the flow meters passed the test on variance and suitability; and data given by the instruments at the stack comply with the data registered in the data acquisition system.

8. GHG Emission Reduction Calculations

8.1. Baseline Emissions

For baseline emission factor determination, N₂O concentration and gas volume flow for each plant were monitored throughout the baseline campaign. Hourly average readings for N₂O concentration and gas flow volume (calculated from data monitored every 2 seconds) were performed. Error readings (e.g. downtime or malfunction) and extreme values were eliminated from the output data series.

Normal operating condition determination

To ensure that data obtained during baseline campaign are representative of the actual GHG emissions from the source plant, a set of process parameters known to affect N₂O generation have been set based on plant historical operating conditions and design data. Those parameters, called by the methodology normal operating conditions, are: oxidation temperature, oxidation pressure, ammonia flow to the reactor and ammonia flow to air flow ratio.

Normal operating conditions determined for Sasolburg and Secunda plants are:

Parameter	Data unit	Value applied
Normal Operating Temperature, OT_{normal} (range of temperature)	°C	For Sasolburg: 703- 884 For Secunda: 860-920
Normal Operating Pressure, OP_{normal} (range of pressure)	bar	For Sasolburg: 3.7 - 4.5 For Secunda: 2.5 - 5.0
Maximum Ammonia Flow Rate, AFR_{max}	kg NH ₃ /hour	For Sasolburg: 6,771 For Secunda: 10,630
Maximum Ammonia to Air Flow Rate, AIFR_{max}	kg NH ₃ /kg air	For Sasolburg: 0.084 For Secunda: 0.063

Only those N₂O measurements taken when the plant was operating within the permitted range were considered in the calculation of baseline emissions.

After eliminating data measured when the plant was operating outside the permitted conditions, the following statistical procedure was applied.

- a) Calculated the sample mean ($\bar{x}$)
- b) Calculated the sample standard deviation (s)
- c) Calculated the 95% confidence interval (equal to 1.96 times the standard deviation)
- d) Eliminated all data that lay outside the 95% confidence interval
- e) Calculated the new sample mean from the remaining values (volume of stack gas (VSG) and N_2O concentration of stack gas (NCSG))

Then, baseline emissions were calculated using the following formulae

$$BE_{BC} = VSG_{BC} \cdot NCSG_{BC} \cdot 10^{-9} \cdot OH_{BC}$$

$$EF_{BL} = \frac{BE_{BC}}{NAP_{BC}} \left(1 - \frac{UNC}{100}\right)$$

Where

BE_{BC}	Total baseline emissions in the baseline measurement period, in t N_2O
VSG_{BC}	Mean stack gas volume flow rate in the baseline measurement period, in Nm ³ /h
$NCSG_{BC}$	Mean concentration of N_2O in the stack gas in the baseline measurement period, in mg N_2O /Nm ³
OH_{BC}	Number of operating hours in the baseline measurement period, in h
EF_{BL}	Baseline emission factor, in t N_2O /t HNO_3
NAP_{BC}	Nitric acid production during the baseline campaign, in t HNO_3
UNC	Overall measurement uncertainty of the monitoring system, in %, calculated as the combined uncertainty of the applied monitoring equipment

Another parameter that is measured and must be compared with the normal value is the campaign length.

Normal campaign length (CL_{normal}) values are:

Sasolburg: 114,727 tonnes HNO_3

Secunda: 183,602 tonnes HNO_3

According to AM0034, the baseline campaign length must be lower than or equal to CL_{normal} .

In the case of a project campaign, the campaign length must be greater than or equal to CL_{normal} .

If the project campaign length is shorter than CL_{normal} the baseline emission factor must be recalculated eliminating N_2O values obtained beyond CL_n . (This data treatment was clearly detailed in Annex 12 of EB51).

At Sasolburg plant the baseline campaign took place between June 12, 2006 and March 5, 2007. EF_{BL} calculation was made using values of $NCSG_{BC}$ from June 12, 2006 to February 3, 2007 in order not to exceed normal campaign length.

To follow the calculations see the following spreadsheets:

- “Sasolburg Baseline Emission Factor rev3.xls”

At Secunda plant the baseline campaign took place between August 29, 2006 and March 23, 2007.

The third project campaign was shorter than normal campaign length. Hence, the EF_{BL} was recalculated using values of $NCSG_{BC}$ measured between August 29, 2006 and March 4, 2007.

To follow the calculations see the following spreadsheets:

- “Secunda Baseline Emission Factor Calculation 15 April 08.xls”
- “Secunda Baseline Emission Factor Re Calculation for Third project campaign ver 1.0.xls”.

Sasolburg plant:

Baseline emission factor

$$BE_{BC} = 71,377 \cdot 3,085 \cdot 10^{-9} \cdot 5,904 = 1307.8 \text{ tonne } N_2O$$

$$EF_{BL} = \frac{1307.8}{130,069} \left(1 - \frac{3.89}{100}\right) = 0.00966 \text{ tonne } N_2O / \text{tonne } HNO_3$$

Secunda plant:

Baseline emission factor applied for third project campaign

$$BE_{BC} = 116,409 \cdot 1,446 \cdot 10^{-9} \cdot 4,810 = 809.78 \text{ tonne } N_2O$$

$$EF_{BL} = \frac{809.78}{172,879} \left(1 - \frac{4.14}{100}\right) = 0.00449 \text{ tonne } N_2O / \text{tonne } HNO_3$$

Baseline emission factor applied for fourth project campaign

$$BE_{BC} = 116,409 \cdot 1,474 \cdot 10^{-9} \cdot 4,810 = 825.29 \text{ tonne } N_2O$$

$$EF_{BL} = \frac{825.29}{172,879} \left(1 - \frac{4.14}{100}\right) = 0.00457 \text{ tonne } N_2O / \text{tonne } HNO_3$$

At both plants the baseline campaigns were valid because for more than 50% of the duration of the baseline, the plant was operated within normal operating conditions. In the case of Sasolburg, the plant operated for 75 % of the campaign duration within normal operating conditions; for Secunda this factor reached 95 %.

8.2. Project Emissions

For project emission factor determination, N_2O concentration and gas volume flow for each plant were monitored throughout the project campaign. Hourly average readings for N_2O concentration and gas volume flow (calculated from data monitored every 2 seconds) were

performed. Error readings (e.g. downtime or malfunction) and extreme values were eliminated from the output data series.

Next, the same statistical evaluation that was applied to the baseline data series was applied to the project data series.

The mean values of N₂O concentration at the stack gas and volume flow rate at the stack gas were used in the following formula (Eq. 3 from AM0034) to calculate project emissions:

$$PE_n = VSG_n \cdot NCSG_n \cdot 10^{-9} \cdot OH_n$$

$$EF_n = \frac{PE_n}{NAP_n}$$

Where

PE_n	Total project emissions of the n th campaign, in tN ₂ O
VSG_n	Mean stack gas volume flow rate for the n th project campaign, in Nm ³ /h
$NCSG_n$	Mean concentration of N ₂ O in the stack gas for the project campaign, in mg N ₂ O/Nm ³
OH_n	Number of operating hours in the project campaign, in h
EF_n	Emission factor calculated for the n th campaign, in tonnes N ₂ O/tonne HNO ₃
NAP_n	Nitric acid production in the n th campaign, in tonnes 100% HNO ₃

Derivation of a moving average emission factor

The methodology proposes the calculation of a moving average emission factor in order to take a conservative approach in emission reduction calculation. The maximum value between EF_n for the specific project campaign and the $EF_{ma,n}$ shall be used in the emission reduction calculation as EF_p emission factor.

$EF_{ma,n}$ is calculated as follows:

$$EF_{ma,n} = \frac{EF_1 + EF_2 + \dots + EF_n}{n} (\text{tonneN}_2\text{O} / \text{tonneHNO}_3)$$

$$\text{If } EF_{ma,n} \geq EF_n, \text{ then } EF_p = EF_{ma,n}$$

$$\text{If } EF_{ma,n} < EF_n, \text{ then } EF_p = EF_n$$

Where

EF_n	Emission factor calculated for the n th campaign, in tonne N ₂ O/tonne HNO ₃
$EF_{ma,n}$	Moving average (ma) emission factor after n^{th} campaign, including the current campaign, in tonne N ₂ O/tonne HNO ₃
n	Number of campaigns to date
EF_p	Emission factor that will be applied to calculate the emission reductions from this specific campaign, in tonne N ₂ O/tonne HNO ₃



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This process is repeated for each campaign such that a moving average, $EF_{ma,n}$, is established over time, becoming more representative and precise with each additional campaign.

At Sasolburg plant the third and fourth project campaigns took place as follows:

Third project campaign: April 21, 2008 to December 7, 2008.

Fourth project campaign: December 11, 2008 to August 3, 2009.

At Secunda plant the third and fourth project campaigns took place as follows:

Third project campaign: August 31, 2008 to April 26, 2009.

Fourth project campaign: May 2, 2009 to January 31, 2010.

The amount of CERs requested in the present Monitoring Report includes partial third project campaign (from August 10, 2008 to December 7, 2008) and complete fourth project campaign of Sasolburg plant; complete third project campaign and partial fourth project campaign (from May 2, 2009 to August 3, 2009) of Secunda plant.

Values obtained for both plants are:

Sasolburg plant

Third project campaign

$$PE_n = 71,360 \cdot 773.88 \cdot 10^{-9} \cdot 5,393.98 = 297.88 \text{ tonne } N_2O$$

$$EF_n = \frac{297.88}{121,814} = 0.00245 \text{ tonne } N_2O / \text{tonne } HNO_3$$

$$EF_{ma,n} = \frac{0.00118 + 0.00147 + 0.00245}{3} = 0.001815 \text{ tonne } N_2O / \text{tonne } HNO_3$$

As EF_n is higher than $EF_{ma,n}$, $EF_p = EF_n = 0.00245 \text{ tonne } N_2O / \text{tonne } HNO_3$

Fourth project campaign

$$PE_n = 72,180 \cdot 135 \cdot 10^{-9} \cdot 5,606 = 54.66 \text{ tonne } N_2O$$

$$EF_n = \frac{54.66}{122,293} = 0.00045 \text{ tonne } N_2O / \text{tonne } HNO_3$$

$$EF_{ma,n} = \frac{0.00118 + 0.00147 + 0.00245 + 0.00045}{4} = 0.000815 \text{ tonne } N_2O / \text{tonne } HNO_3$$

As $EF_{ma,n}$ is higher than EF_n , $EF_p = EF_{ma,n} = 0.000815 \text{ tonne } N_2O / \text{tonne } HNO_3$

Secunda plant

Third project campaign

$$PE_n = 107,922 \cdot 1243 \cdot 10^{-9} \cdot 4,841 = 649.68 \text{ tonne } N_2O$$

$$EF_n = \frac{649.68}{157,498} = 0.00412 \text{ tonne } N_2O / \text{tonne } HNO_3$$

$$EF_{ma,n} = \frac{0.00215 + 0.00197 + 0.00412}{3} = 0.00314 \text{ tonne } N_2O / \text{tonne } HNO_3$$

As EF_n is higher than $EF_{ma,n}$, $EF_p = EF_n = 0.00412 \text{ tonne } N_2O / \text{tonne } HNO_3$

Fourth project campaign

$$PE_n = 113,387 \cdot 987 \cdot 10^{-9} \cdot 5,566 = 623.16 \text{ tonne } N_2O$$

$$EF_n = \frac{623.16}{195,249} = 0.00319 \text{ tonne } N_2O / \text{tonne } HNO_3$$

$$EF_{ma,n} = \frac{0.00215 + 0.00197 + 0.00412 + 0.00319}{4} = 0.00267 \text{ tonne } N_2O / \text{tonne } HNO_3$$

As EF_n is higher than $EF_{ma,n}$, $EF_p = EF_n = 0.00319 \text{ tonne } N_2O / \text{tonne } HNO_3$

Complete project emission factor calculations are in the following documents:

- “Sasolburg Third project campaign (10 Aug 08 to 07 Dec 08)-ver 1.0.xls”
- “Sasolburg Fourth Project Campaign- ver 1.0.xls”
- “Secunda Third Project Campaign- ver 1.0.xls”
- “Secunda Fourth Project Campaign (2May 09 to 3Aug 09)- ver 1.0.xls”.

8.3. Emission Reduction Calculation

As indicated, the present Monitoring Report involves the following period: From August 10, 2008 to August 3, 2009.

According to AM0034 version 2, the emission reductions for the project activity over a specific campaign are determined as follows:

$$ER_n = (EF_{BL} - EF_p) \cdot NAP_n \cdot GWP_{N_2O}$$

Where

ER_n	Emission reductions of the project for the n th campaign, tCO ₂ e
EF_{BL}	Baseline emission factor, in tN ₂ O/tHNO ₃
EF_p	Project emission factor, applicable to the n th campaign, in tN ₂ O/tHNO ₃
NAP_n	Nitric acid production during the n th campaign of the project activity, in tHNO ₃
GWP_{N_2O}	Global warming potential of N ₂ O, set as 310 tCO ₂ e/tN ₂ O for the 1 st commitment period

Values obtained for the project are:

Sasolburg plant

Third project campaign

$$ER_n = (0.00966 - 0.00245) \cdot 63,848 \cdot 310 = 142,705 \text{ tonneCO}_2\text{e}$$

Fourth project campaign:

$$ER_n = (0.00966 - 0.000815) \cdot 122,293 \cdot 310 = 335,322 \text{ tonneCO}_2\text{e}$$

Secunda plant

Third project campaign

$$ER_n = (0.00449 - 0.00412) \cdot 157,498 \cdot 310 = 18,065 \text{ tonneCO}_2\text{e}$$

Fourth project campaign

$$ER_n = (0.00457 - 0.00319) \cdot 53,204 \cdot 310 = 22,760 \text{ tonneCO}_2\text{e}$$

Then, the total amount of emission reductions due to the implementation of the project activity during the monitoring period is:

$$ER = 142,705 + 335,321 + 18,065 + 22,760 = 518,851 \text{ tonneCO}_2\text{e}$$

Complete emission reduction calculations are in the following documents:

- “Sasolburg Third project campaign (10 Aug 08 to 07 Dec 08)-ver 1.0.xls”
- “Sasolburg Fourth Project Campaign- ver 1.0.xls”
- “Secunda Third Project Campaign- ver 1.0.xls”
- “Secunda Fourth Project Campaign (2May 09 to 3Aug 09)- ver 1.0.xls”.

Comment: The numbers including in this monitoring report were copied from the abovementioned spreadsheets.

The calculations in the spreadsheets were made using the values of each parameter informed by the plants, with all their significant figures.

Values of EF_{BL} and CERs were truncated and values of EF_n were rounded in order to obtain more conservative figures.

Annex 1- Instrument list- Sasolburg plant

Instrument	TAG	Brand	Model	Calibration frequency	Latest calibration date	Previous calibration date
N ₂ O analyzer	302AI401D	ABB	ABB AO 2040 and Uras 14	Weekly	24/03/2010	17/03/2010
Stack gas flow meter	302FI408	SICK	FLWSIC 100	2 Yearly verification	Aug 2009	Sept 2008
Stack pressure meter	302PI405	ROSEMOUNT	3051	Yearly	Aug 2009	Sept 2008
Stack temperature meter	302TI414	ENDRESS & HAUSER	iTEMP TMT 181	Yearly	Aug 2009	Sept 2008
Oxidation pressure meter	302PI128	ROSEMOUNT	3051S2CD1	Yearly	Dec 2008	Aug2009
Oxidation temperature meter	302TI102	ENDRESS & HAUSER	iTEMP TMT 181	Yearly	Dec 2008	Aug2009
	302TI103A	ENDRESS & HAUSER	iTEMP TMT 181	Yearly	Dec 2008	Aug2009
	302TI103B	ENDRESS & HAUSER	iTEMP TMT 181	Yearly	Dec 2008	Aug2009
Nitric acid production flow meter	302FI127	ROSEMOUNT	RFT9739D4SU 4	Yearly	Apr 2008	Dec 2009
Ammonia flow meter to ammonia/air mixer	302FI170A	ROSEMOUNT	3051	Yearly	Dec 2008	Aug2009
	302FI170B	ROSEMOUNT	3051	Yearly	Dec 2008	Aug2009
	302FI170C	ROSEMOUNT	3051	Yearly	Dec 2008	Aug2009
Air flow meter to ammonia/air mixer	302FI106A	ROSEMOUNT		Yearly	Dec 2008	Aug2009



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Annex 2- Instrument list- Secunda plant

Instrument	TAG	Brand	Model	Calibration frequency
N ₂ O analyzer	AI_0130	ABB	AO 2040	Weekly
Stack gas flow meter	302FI408	SICK	FLowsic 100	2 Yearly
Stack pressure meter	PI_0135A	ROSEMOUNT	3095	Yearly
Stack temperature meter	TI_0135A	ROSEMOUNT	3095	Yearly
Oxidation temperature meter	TI_0121	Honeywell DCS	ST3000	Yearly
Oxidation pressure meter	PI_0104	Honeywell	ST3000	Yearly
Ammonia flow meter to ammonia/air mixer	FI_0103	Honeywell	ST3000	Yearly
Air flow meter to ammonia/air mixer	FI_0104	Honeywell	ST3000	Yearly
Nitric acid production flow meter	FI_1501	Endress & Hauser	Promass 83F	exchange and check instrument with every gauze change as from 2009

Annex 3-Relevant event summary- Secunda plant

The following tables contain the relevant events that occurred during third and fourth project campaigns.

Operation logbook

Date	Event	Impact on N2O data generation/acquisition OR N2O abatement performance	Reference Document
31-Aug-08	Plant trip	Plant trip - Partial data acquisition	Operations logbook
1-Sep-08	Plant Offline		Operations logbook
2-Sep-08	Plant Offline		Operations logbook
3-Sep-08	Plant Offline		Operations logbook
4-Sep-08	Plant startup	Plant startup - Partial data acquisition	Operations logbook
10-Sep-08	Plant Stop	Plant trip - Partial data acquisition	Operations logbook
From 11-Sep-08 to 17-Sep-08	Plant Offline	Plant offline - No data was acquired	Operations logbook
18-Sep-08	Plant startup		Operations logbook
From 20-Sep-08 to 24-Sep-08	Plant Offline		Operations logbook
25-Sep-08	Plant startup		Operations logbook
20-Oct-08	Plant trip		Operations logbook
21-Oct-08	Plant offline		Operations logbook
22-Oct-08	Plant startup		Operations logbook
From 1-Jan-09 to 6-Jan-09	Normal Operation	Analyser faulty	Operations logbook
12-Jan-09	Plant Offline		Operations logbook
13-Jan-09	Plant Offline		Operations logbook



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14-Jan-09	Plant Offline		Operations logbook
15-Jan-09	Plant Offline		Operations logbook
From 22-Jan-09 to 2-Feb-09	Normal Operation	Analyser faulty	Operations logbook
3-Feb-09	Plant Offline		Operations logbook
4-Feb-09	Plant Offline		Operations logbook
5-Feb-09	Plant Offline		Operations logbook
6-Feb-09	Plant Offline		Operations logbook
1-May-09	Normal Operation	Plant startup - Partial data acquisition	Operations logbook
30-May-09	Plant Offline	Plant stopped 22 hours on line - Partial data acquisition	Operations logbook
From 31-May-09 to 25-Jun-09	Plant Offline	Shutdown	Operations logbook
26-Jun-09	Plant Offline	Start-up, plant tripped due to high vacuum 8 hours online, fault analyser	Operations logbook
27-Jun-09	Plant Offline	Start-up-fault analyser	Operations logbook
28-Jun-09	Normal Operation	Analyser faulty	Operations logbook
29-Jun-09	Normal Operation	Analyser faulty	Operations logbook
30-Jun-09	Plant Offline	Anti surge trip, Start-up online for 9 hours	Operations logbook
1-Jul-09	Plant Offline	High evaporator level trip, Start-up online for 17 hours	Operations logbook
15-Jul-09	Plant Offline	Solenoid on ammonia pressure controller froze	Operations logbook
18-Jul-09	Plant Offline	Plant trip: Thermocouple failure	Operations logbook
19-Jul-09	Plant Offline	Start-up	Operations logbook
20-Jul-09	Plant Offline	Plant trip: Instrument trip, surge on air compressor	Operations logbook
21-Jul-09	Plant Offline	Start-up	Operations logbook
9-Aug-09	Plant Offline	AmmoniumNitrate storage tank valves leaking plant online for 7.5 hours	Operations logbook
10-Aug-09	Plant Offline	AmmoniumNitrate storage tank valves leaking and plant startup online for 10.5 hours	Operations logbook



11-Aug-09	Normal Operation	Analyser faulty	Operations logbook
8-Sep-09	Plant Offline	Ratio trip on ammonia control online for 17 hours	Operations logbook
9-Sep-09	Plant Offline	Lamont repairs	Operations logbook
10-Sep-09	Plant Offline	Lamont repairs	Operations logbook
11-Sep-09	Plant Offline	Ammonia ratio trip online for 12.5 hours	Operations logbook
12-Sep-09	Plant Offline	Ratio trip tailgas turbine caught fire	Operations logbook
13-Sep-09	Plant Offline	Ratio trip tailgas turbine caught fire online for 23.25 hours	Operations logbook
20-Sep-09	Plant Offline	Quick release solenoid on blow off corroded online for 15 hours	Operations logbook
26-Oct-09	network failure	Analyser faulty	Operations logbook
31-Dec-09	Plant offline	Level indicator failure on cooler condensor online for 15.75 hours	Operations logbook
1-Jan-10	Plant offline	Tube leaks on Lamont Boiler	Operations logbook
2-Jan-10	Plant offline	Tube leaks on Lamont Boiler	Operations logbook
3-Jan-10	Plant offline	Tube leaks on Lamont Boiler	Operations logbook
4-Jan-10	Plant offline	Tube leaks on Lamont Boiler	Operations logbook
5-Jan-10	Plant offline	Tube leaks on Lamont Boiler	Operations logbook
6-Jan-10	Calibration - Zero and Span checks	Tube leaks on Lamont Boiler	Operations logbook
7-Jan-10	Plant offline	Power failure on incoming supply 15 hours online	Operations logbook
31-Jan-10	Plant offline	catalyst change	Operations logbook

Annex 4- Relevant event summary- Sasolburg plant

The following tables contain the relevant events that occurred during the third project campaign.

Operation logbook- Third project campaign

Date	Lost time	Event	Reference Document
24-Apr-08	4,5	Vibrations	Nox logbook Report
26-Apr-08	8,00	Vibrations	Nox logbook Report
27-Apr-08	22,5	Vibrations	Nox logbook Report
28-Apr-08	24,0	Vibrations	Nox logbook Report
29-Apr-08	0,15	Vibrations	Nox logbook Report
30-Apr-08	2,29	Vibrations	Nox logbook Report
01-May-08	3,26	Compressor Vibrations	Nox logbook Report
09-May-08	3,18	Cooling Water Flow	Nox logbook Report
22-May-08	0,20	Power Dip	Nox logbook Report
23-Jun-08	0,3	High Gauze Temp	Nox logbook Report
22-Ago-08	3,00	11KV Trip Plant	Nox logbook Report
16-Sep-08	2,00	NH3 pressure fall 201B	Nox logbook Report
24-Sep-08	0,00	Compressor Trip	Nox logbook Report
25-Sep-08	1,50	Compressor Trip	Nox logbook Report
26-Sep-08	7,00	Compressor Discharge	Nox logbook Report
18-Oct-08	7,50	Lighting Trip Compressor. Clean Oil Cooler	Nox logbook Report
26-Nov-08	4,33	HIC 106-Selonoid + Low Gauze Temp	Nox logbook Report
07-Dic-08	6,51	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
08-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
09-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
10-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
11-Dic-08	17,18	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report



AMS logbook- Third project campaign

Date	Lost time	Event	Reference Document
24-Apr-08	4,00	Nitric Off	Nox logbook Report
26-Apr-08	8,30	Nitric Off	Nox logbook Report
27-Apr-08	20,00	Nitric Off	Nox logbook Report
28-Apr-08	24,00	Nitric Off	Nox logbook Report
29-Apr-08	6,20	Nitric Off	Nox logbook Report
30-Apr-08	0,48	Nitric Off	Nox logbook Report
01-May-08	3,57	Compressor Vibrations	Nox logbook Report
23-Jun-08	1,15	Nitric Trip	Nox logbook Report
13-Jul-08	1,30	AN Pant Trip FIR01B Cold flow Full	Nox logbook Report
14-Ago-08	0,10	AN Plant Trip on NH3 Press Low To Reactor	Nox logbook Report
22-Ago-08	3,30	11KV Trip Plant	Nox logbook Report
27-Ago-08	2,30	Stop AN Plant AN Circulation	Nox logbook Report
28-Ago-08	0,45	HN03 Flow and NH3 Flow	Nox logbook Report
29-Ago-08	0,30	HN03 Flow and NH3 Flow	Nox logbook Report
02-Sep-08	20,00	AN Plant Trip Pall203 Faulty	Nox logbook Report
08-Sep-08	10,00	AN Plant Trip Pall203	Nox logbook Report
16-Sep-08	0,45	Pall Replaced	Nox logbook Report
25-Sep-08	1,50	Water In NH3	Nox logbook Report
26-Sep-08	0,15	Water In NH3	Nox logbook Report
18-Oct-08	8,14	Lightning Trip Compressor. Clean Oil Cooler	Nox logbook Report



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26-Nov-08	2,51	Compressor Trip	Nox logbook Report
08-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
09-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
10-Dic-08	24,00	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report
11-Dic-08	16,13	Shutdown New Catalyst, Gauzes & Basket	Nox logbook Report

The following tables contain the relevant events that occurred during the fourth campaign.

Operation logbook- Fourth project campaign

Date	Lost time	Event	Reference Document
14-Dic-08	0,25	High Gauze Temp	Nox logbook Report
29-Dic-08	5,12	Compressor Tripped Out (Faulty cut off valves)	Nox logbook Report
30-Dic-08	3,10	Compressor Tripped Out (Faulty cut off valves)	Nox logbook Report
26-Ene-09	5,50	DCS HIC 106 - Software	Nox logbook Report
27-Ene-09	4,20	XV 105 - People doing lagging	Nox logbook Report
14-Feb-09	0,30	Trip Flow Ration Nap	Nox logbook Report
19-Mar-09	3,41	AN Factory Export pumps shaft broke	Nox logbook Report
20-May-09	9,20	Contractors damage electical feed cable to utilities building.	Nox logbook Report
24-May-09	2,00	Boiler feed water pump tripped	Nox logbook Report
03-Ago-09	8,50	Gauze Change	Nox logbook Report
04-Ago-09	24,00	Gauze Change	Nox logbook Report
05-Ago-09	24,00	Gauze Change	Nox logbook Report
06-Ago-09	24,00	Gauze Change	Nox logbook Report
07-Ago-09	24,00	Gauze Change	Nox logbook Report



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08-Ago-09	16,50	Gauze Change	Nox logbook Report
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AMS logbook- Fourth project campaign

Date	Lost time	Event	Reference Document
29-Dic-08	5,00	Compressor Tripped Out (Faulty cut off valves)	Nox logbook Report
30-Dic-08	4,10	Compressor Tripped Out (Faulty cut off valves)	Nox logbook Report
06-Ene-09	1,50	Changed HN03 Flow. Mgn Flow	Nox logbook Report
26-Ene-09	5,08	Compressor Trip	Nox logbook Report
14-Feb-09	0,03	Factory Export pumps tripped	Nox logbook Report
19-Mar-09	1,40	Factory Export pumps shaft broke	Nox logbook Report
31-Mar-09	0,10	HN03 to reactor flow meter full away. (Pump pressure drop)	Nox logbook Report
20-May-09	8,25	Electrical cable damage NAP plant off line	Nox logbook Report
03-Ago-09	8,28	Gauze Change	Nox logbook Report
04-Ago-09	24,00	Gauze Change	Nox logbook Report
05-Ago-09	24,00	Gauze Change	Nox logbook Report
06-Ago-09	24,00	Gauze Change	Nox logbook Report
07-Ago-09	24,00	Gauze Change	Nox logbook Report
08-Ago-09	16,00	Gauze Change	Nox logbook Report



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