AKCINĖ BENDROVĖ
ACHEMA

JI Project

Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertiliser Factory

MONITORING REPORT

FIRST PROJECT CAMPAIGN
16/08/2008 - 26/09/2009

Version 1.7

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20 April 2010

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Introduction

The Joint Implementation project "Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertiliser Factory" was successfully carried out by installing secondary catalyst in August 2008. The baseline campaign was launched from September 2007 to July 2008 during which emissions were monitored to determine the baseline emissions of the plant. After installing of the secondary catalyst, the first project campaign was launched and the project emissions monitored until the end of the campaign – 26 September 2009.

This report describes the monitoring measures implemented within the frame of JI project during a period of 16.08.2008 – 26.09.2009. It evaluates the achieved emission reductions for a given period and resumes steps, which were carried out in accordance with the Monitoring plan and the requirements of the CDM methodology AM0034 v02.

1. JI project design

1.1 Engineering solution for N2O reduction

BASF technology was applied by introducing a new catalyst bed which was installed in a new basket, directly under the Platinum gauze in the nitric acid reactors. The technology is owned and patented by BASF (German patent BASF Catalysts 03-85), and has also been installed in several other plants.

The secondary catalyst (on Al_2O_3 basis with active metal oxides CuO and ZnO) was installed underneath the platinum gauze. In order to be able to install a secondary catalyst the reconstruction of a burner basket was performed to make required 20-100 mm additional free space under the Platinum gauze.

Everything was prepared for the basket reconstruction and the catalyst replacement in the middle of July 2008. The GP plant was stopped on 28th July 2008 and after the cooling of the production line the old basket was dismantled. The installation of the new basket was successful as well as the installation of the secondary catalyst. The new catalyst's 03-85 shape is a extrudated Stars 3 mm. The free space in the basket was filled with ceramic Raschig rings and the test of GP plant operation was performed on 16th August 2008. The plant started fully operating at 1am on 17th August 2008.

The lifetime of the secondary catalyst is about 3 campaigns (lifetime of the platinum gauze), i.e. length of a campaign about 330 days in the high-pressure nitric acid reactors and about 1000 days in the medium-pressure nitric acid reactors. The guaranteed efficiency of the BASF secondary catalyst was about 80%. The average efficiency has reached up to 88 % during first project campaign.

1.2 Monitoring system

The N_2O monitoring system is designed according to the requirements set in the approved CDM baseline methodology AM0034 v02.

Baseline emissions were monitored and calculated by continuous multi-component measuring system Advance Cemas-NDIR manufactured by ABB, prior to installation of secondary catalysts.

The monitoring system allows to measure N_2O concentration in the tail gas flow continuously during the entire lifespan of the primary catalysts in the oxidation reactor i.e. for approximately 11 months.

The monitoring system was installed, adjusted and launched on 30th June 2007 at the end of the campaign IV. Campaign V (baseline campaign) was launched on 5th September 2007. Emissions were monitored during the entire baseline campaign after which, a secondary catalyst was installed and the first project campaign (VI) was launched.

Monitoring results of the baseline campaign give an average value of N_2O emissions released to the atmosphere while producing 1 t of HNO_3 without abatement technique. After the installation of the secondary catalyst, the baseline emissions were compared to the actual emissions that were also continuously measured. The difference between baseline emissions and actual emissions after the installation of the secondary catalyst give emission reduction values.

Location of sampling probes for on-line measurement of tail gas volume flow, temperature, pressure and N_2O concentration with ABB multi-component measuring system at GP nitric acid plant are shown in a figure below.

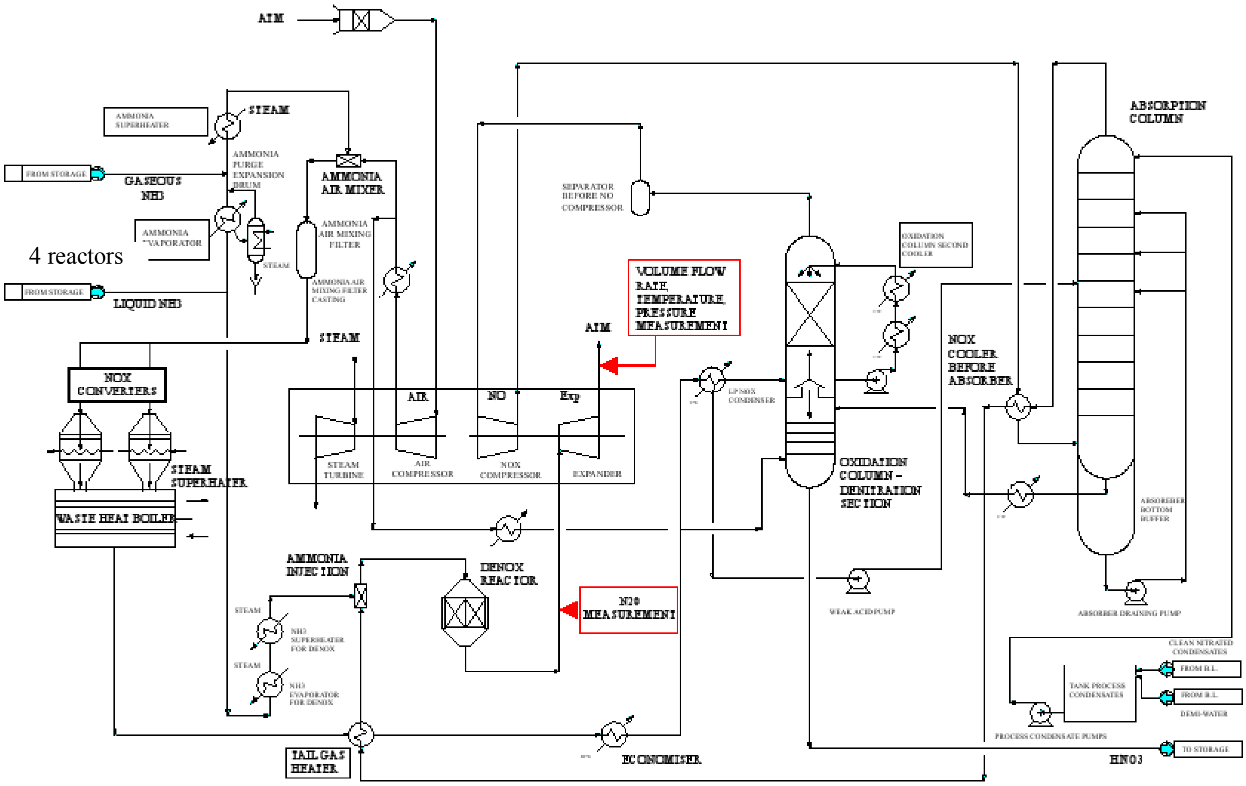


Figure 1 Sampling points for N_2O monitoring at GP plant

As it can be seen on the process scheme above, the volume flow, temperature and pressure measuring probe is installed after expander unit and N_2O sampling probe directly after DeNOx reactor.

Flow volume, temperature and pressure of the tail gas are measured separately from N_2O because length of straight duct at the N_2O sampling point is not long enough according to requirements for such measurements.

The N_2O monitoring system at GP plant consists of the following components:

- ✓ N_2O analyzer AO-2000-URAS-26 (ABB)
- ✓ Flow meter DELTAFLOW (Systec)
- ✓ Data Server EMI 3000
- ✓ Distributed control system (DCS)

A simplified scheme of the monitoring system is presented below:

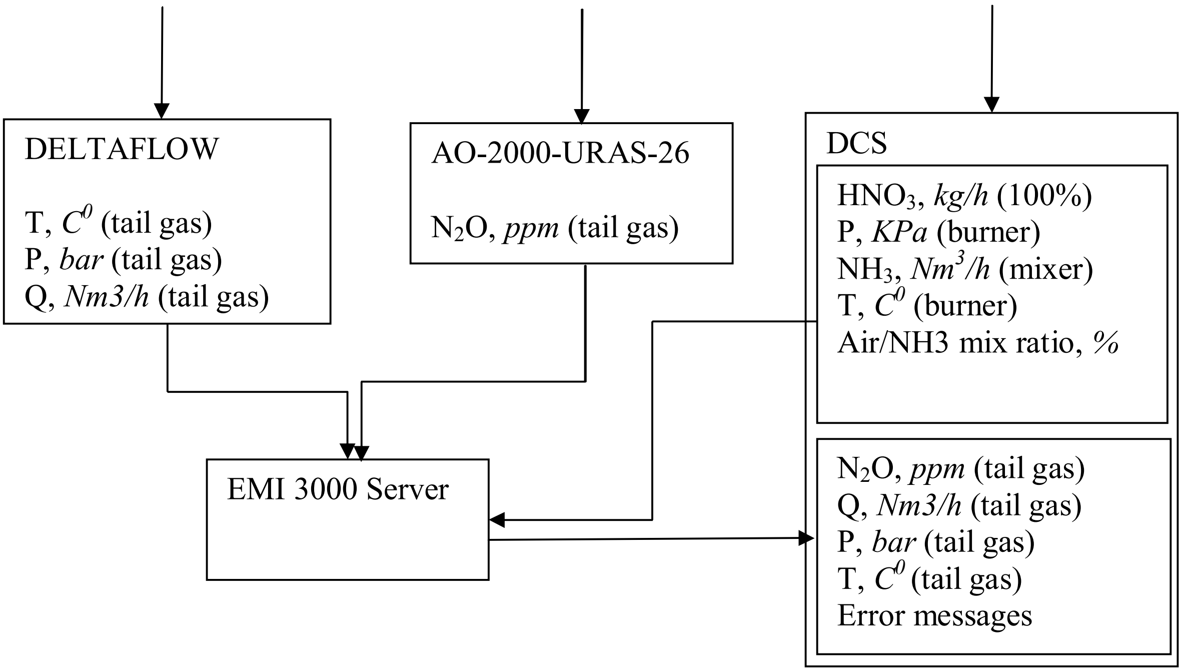


Figure 2 Automated monitoring system at GP plant

A flow meter measures volume flow (m^3/h), temperature and pressure in the tail gas and sends signals to the server. The server stores data and forwards signal to the Distributed Control System (DCS). The N_2O analyzer continuously measures concentration of N_2O in the tail gas and also sends signal to the data server which forwards it to DCS.

The AM0034 methodology requires monitoring scheme to be installed according to the European Norm 14181 (2004). The Norm requires evaluation of the automated measuring system (AMS) against three Quality Assurance Levels (QAL1, QAL2 and QAL3) and an Annual Surveillance Test (AST). Besides that, it must be ensured that the automated measuring system (AMS) is installed in accordance with the relevant European/ international standards and manufacturer requirements and functional test is performed at the commissioning of the AMS.

QAL1 procedure requires compliance of the equipment with EN ISO 14956. AO-2000-URAS-26 and DELTAFLOW are ISO 14956 certified by the manufacturers.

QAL2 procedure requires determination of the calibration function and a test of the measured values of the AMS compared with the uncertainty given by legislation. During the maintenance period of the GP plant (July 2008) the openings required for QAL2 tests were made in the duct. QAL2 procedure was performed by an accredited independent entity. QAL2 test results were then integrated into the calculations performed by the monitoring software - CDMN2O.

QAL3 is a procedure to check drift and precision in order to demonstrate that the AMS is in control during its operation so that it continues to function within the required specifications for uncertainty. QAL3 is performed automatically as the system calibrates itself once a week. In addition, Achema's experts perform maintenance of the equipment such as fixing faults, changing filters, removing condensate from the system etc.

AST is a procedure to evaluate whether the measured values obtained from the AMS still meet the required uncertainty criteria – as demonstrated in the previous QAL2 test. AST is set to be performed annually by a selected validator.

The AM0034 requires determining the normal ranges for operating conditions for the following parameters: (i) oxidation temperature; (ii) oxidation pressure; (iii) ammonia gas flow rate, and (iv) air input flow rates. To calculate the "permitted range" for oxidation temperature and pressure, a historical data method was chosen and the permitted range then was entered into the AMS. The oxidation temperatures OT from all 4 reactors were included into the calculations. OT values of reactor No.1. were taken from EMI3000 system while OT values of reactors No.2, No.3, and No.4. were taken from DCS (Foxboro). N_2O values outside normal operating conditions i.e. outside OT permitted range presented in the PDD were eliminated.

1.3 Data processing system

The data processing system consists of the following components:

- Data logger CX1000
- Data server EMI3000
- External Backup harddrive
- Software CDMN2O

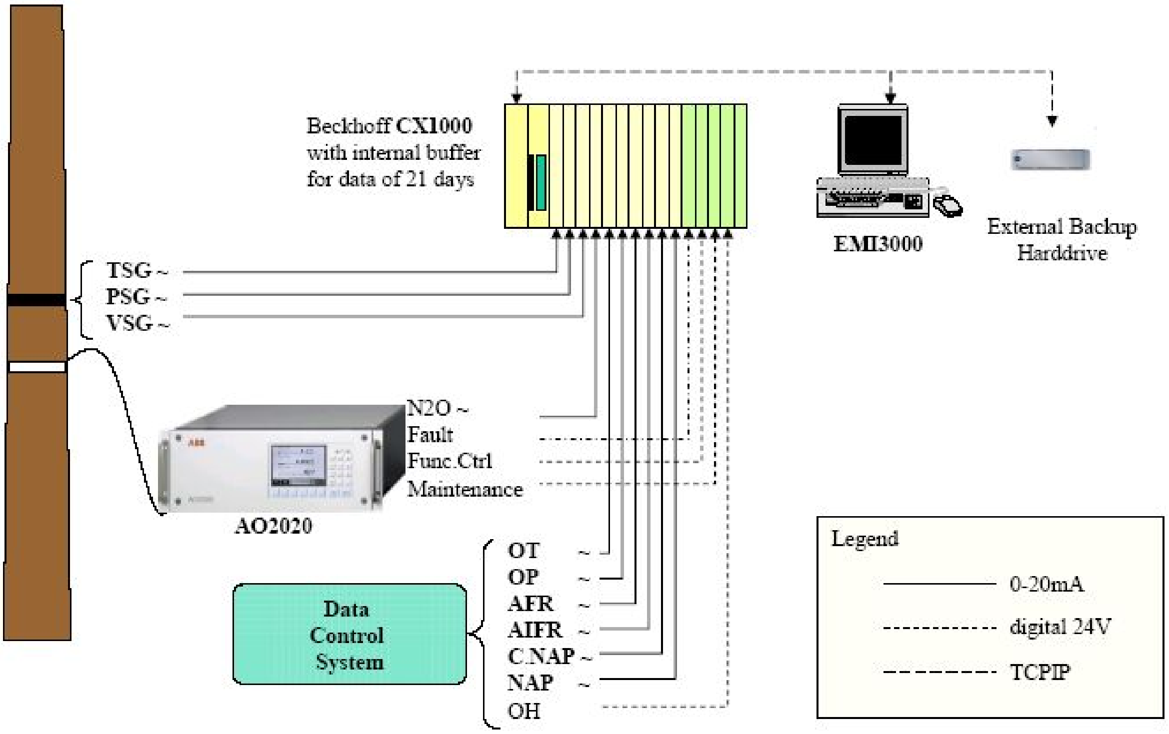


Figure 3 Data processing system

The Data logger CX1000 continuously reads and stores digital data of the monitoring system while EMI3000 handles the communication with the datalogger and evaluates continuously physical second values with status information. Based on this second values 60-minutes averages with status information are calculated.

All data are stored in a MySql-database and thus available for further evaluation. It is also backed up in the external hard drive disc.

Emission calculations are performed by CDMN2O (Version 1.0) software of AFRISO which allows to evaluate data according to the requirements of the approved CDM baseline methodology AM0034. Software is installed on the same PC running EMI3000 and is accessing its database.

All additional adjustments required by AM0034 and a verifier are performed manually in the excel sheets. Some adjusted data of NAP (Nitric Acid Production) from manual calculations is fed back to the monitoring system. The calculation files also serve as a basis for crosscheck of the monitoring accuracy.

The software used in the monitoring system is in compliance with AM0034 requirements. EMI3000 and CDMN2O are operated by a responsible engineer of AB Achema subsidiary "Sistematika" weekly maintenance and additional services related to the software are provided by AFRISO-EURO-INDEX GmbH.

2. Evaluation of the monitoring data

2.1 Monitoring data acquired

According to the Monitoring plan these parameters have been monitored and archived by EMI3000, and transferred to CDMN2O programme:

OH [s] Operating Hours - derived from Digital Input „In Operation"
OT [°C] Oxidation Temperature
OP [kPa] Oxidation Pressure
AFR [kg/h] Ammonia Flow
AIFR [%] Ammonia/Air-Ratio
PSG [hPa] Pressure of stack gas
TSG [°C] Temperature of stack gas
VSG, oc [m³/h] Volume Flow rate of the stack gas insitu
VSG, norm [Nm³/h] Volume Flow rate of the stack gas (normalized)
NCSG[L] [mg/m³] N20 concentration in tail gas Low Range
#NCSG[L] [s] N20 Low Range: Valid Counter = incremented if in Low Range and valid
NCSG[H] [mg/m³] N20 concentration in tail gas High Range
#NCSG[H] [s] N20 High Range: Valid Counter = incremented if in high Range and valid
NCSG [mg/m³] N20 concentration in tail gas
C(NAP) [%] Concentration of HNO3
NAP (op) [t/h] HNO3-Production
NAP [t/h] HNO3-Production at 100%-conc. = C(NAP) * NAP.(op)

Mass rate of the N_2O flow is automatically calculated from the data of N_2O concentration in the tail gas and from its flow rate. The calculation is executed automatically in the EMI3000, where the calculated data is stored and archived. All required calculation adjustments are performed manually in excel sheets, and are archived for the future reference.

2.2 Methodology

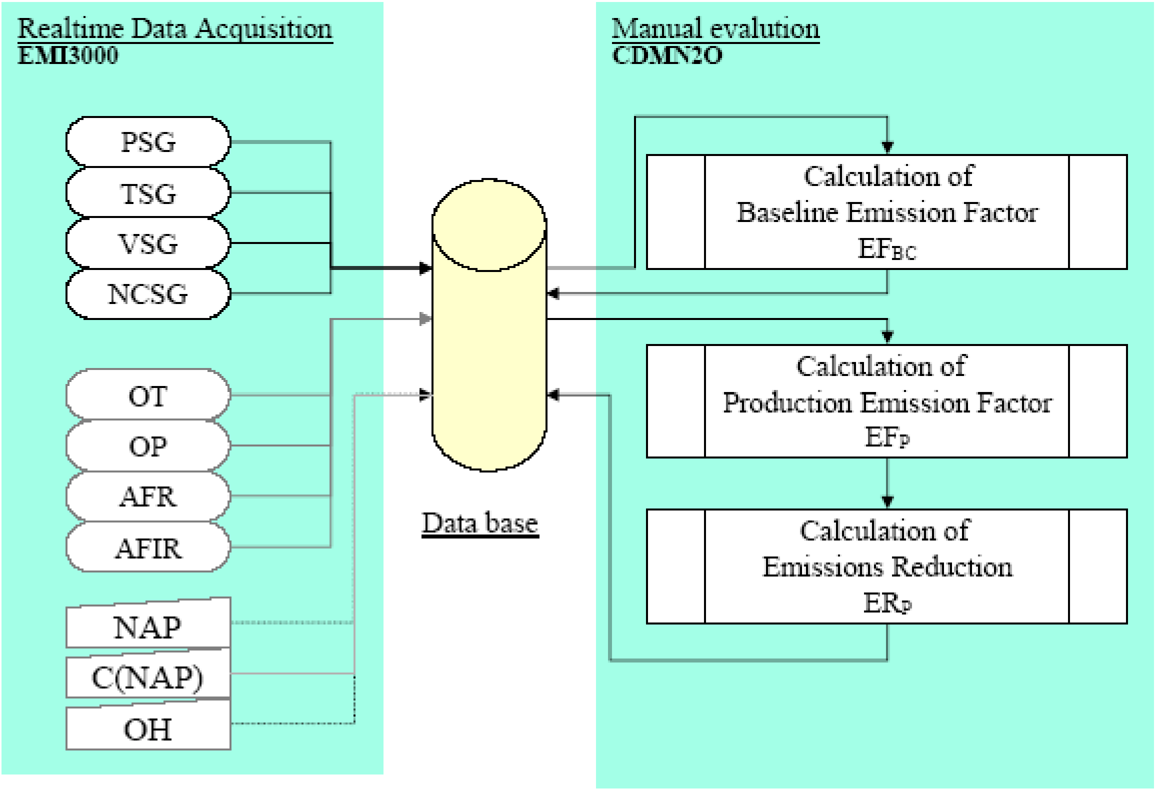


Figure 4 Data evaluation process

General evaluation rules are as follows:

- values for VSG, NSCG when OT, OP, AFR, AIFR inside permitted range:

$$OT_{min} < OT_h < OT_{max}$$
$$OP_{min} < OP_h < OP_{max}$$
$$AFR_{min} < AFR < AFR_{max}$$
$$AIFR_{min} < AIFR < AIFR_{max}$$

- values for VSG, NSCG are inside 95%-confidence interval

VSG is measured and recorded in to EMI3000 system every two seconds with units m^3/h and in the same time VSG is normalized with PSG and TSG and is recorded with units Nm^3/h every two seconds in EMI3000 system. In order to normalise VSG, PSG (hPa) and TSG (^{o}C) are measured and recorded every two seconds. In EMI3000 system normalization of VSG is performed by formula:

VSG (Nm^3/h)= VSG(m^3/h)*273/(TSG+273)*PSG/1013

According to material balance the moisture content in the exhaust gas is 0.53 vol%. For water content of 3,35 g H2O /kg gas (= 0.53 vol%) the dew point is -0.7 °C, while operating temperature in stack gas does not go below 22 °C. Due to negligible error it is not necessary to consider the water content in the calculation of the N2O concentration.

According the historical data provided in the PDD, AFR_{max} was set with units Nm^3/h (15149,2 Nm^3/h). In the EMI3000 system AFR values are monitored and stored with units kg/h. Therefore the AFR_{max} range is converted from Nm^3/h in to kg/h by formula:

15149,2 *(17*1000 / 22,4 *1000) =11497,16 kg/h.

17(g/mol) – mole weight of ammonia
22,4 (mol/l) – volume of 1 mole

The same conversion was used for AFRmin range:

12679,4 *(17*1000 / 22,4 *1000) =9622,76 kg/h.

Emission reduction calculations are performed with units of AFR kg/h.

The basic formula used to calculate emission reductions by CDMN2O software is the following:

$$ER = (EF_{BI} - EF_{P}) * NAP_{P} * GWP_{N2O}$$

ER_{P} = campaign specific emission reduction $[t\ CO_2]$
EF_{BI} = N_2O Baseline Emission Factor $[t\ N_2O\ /\ t\ HNO_3]$
EF_{P} = N_2O Production Emission Factor $[t\ N_2O\ /\ t\ HNO_3]$
NAP_{P} = HNO_3 production during Production campaign $[t\ HNO_3]$
GWP_{N2O} = constant 310.0 $[t\ CO2\ /\ t\ N_2O]$

The intermediate calculation is as follows:

1. Calculation of Baseline Emissions

$$BE_{BC} = VSG_{BC,95\%} * NSCG_{BC,95\%} * 10^{-9} * OH_{BC}\ [t\ N_2O]$$

BE_{BC} = N2O Baseline Emissions $[t\ N_2O]$
$VSG_{BC,95\%}$ = average stack flow inside 95%-confidence interval $[Nm_3/h]$
$NSCG_{BC,95\%}$ = average N2O-concentration inside 95%-confidence interval $[mg/Nm_3]$
OH_{BC} = operating hours [h]

2. Calculation of Baseline Emission Factor

$$EF_{BL} = BE_{BC} / NAP_{BC} * (1 - UNC / 100\%)\ [t\ N_2O\ /\ t\ HNO_3]$$

EF_{BI} = N_2O Baseline Emission Factor $[t\ N_2O\ /\ t\ HNO_3]$
BE_{BC} = N_2O Baseline Emissions $[t\ N_2O]$
NAP_{BC} = HNO3 Production during campaign $[t\ HNO_3]$
UNC = total uncertainty of system [%]

3. Calculation of Campaign Emissions

$$PE_{n} = VSG_{n,95\%} * NSCG_{n,95\%} * 10^{-9} * OH_{n}\ [t\ N_2O]$$

PE_{n} = N_2O Campaign Emissions $[t\ N_2O]$
$VSG_{n,95\%}$ = average stack flow inside 95%-confidence interval $[Nm_3/h]$
$NSCG_{n,95\%}$ = average N_2O-concentration inside 95%-confidence interval $[mg/Nm_3]$

OH_n = operating hours [h]

4. Calculation of Campaign Emission Factor

$$EF_n = PE_n / NAP_n \ [t\ N_2O / t\ HNO_3]$$

EF_n = N_2O Campaign Emission Factor [t N_2O / t HNO_3]
PE_n = N_2O Campaign Emissions [t N_2O]
NAP_n = HNO_3 Production during campaign [t HNO_3]

2.3 Illustration of Calculations

$$BE_{BC} = 139117.38 * 2640.18 * 10^{-9} * 7589 = 2787.401 \text{ t } N_2O$$

$$EF_{BL} = 2787.401 / 299803.81 * (1\text{-}5.12/100) = 0.008821 \text{ t } N_2O/\text{t } HNO_3$$

$$PE_n = 133816.79 * 302.68 * 10^{-9} * 7677 = 310.949 \text{ t } N_2O$$

$$EF_n = 310.949 / 291805.31 = 0.001066 \text{ t } N_2O/\text{t } HNO_3$$

$$ER = (0.008821 – 0.001066) * 291805.31 * 310 = 701550.36 \text{ t } CO_2$$

* Values presented in calculations in this chapter are rounded to 2 digits after coma, therefore can give a small deviation from figures in excel sheets where the values are not rounded.

2.4 Data correction

The data obtained during the downtime, malfunction or maintenance of the monitoring system was handled according to AM0034 (v02) methodology by using CDMN2O software and additional calculation sheets. Al data handling during these periods is described in the JI manual for GP plant, which is used by plant's personnel as a reference.

2.5 Campaign length

According to the AM0034 methodology (v02), EF_{BL} has to be recalculated in two cases:

1. if $CL_{BL} > CL_{normal}$
2. if $CL_n < CL_{normal}$

where:

CL_{BL} – length of the baseline campaign
CL_{normal} – average historic campaign length
CL_n – length of a project campaign

According to the monitoring results:

CL_{BL} = 299803.81 t HNO_3
CL_{normal} = 303129.33 t HNO_3
CL_1 = 291805.31 t HNO_3

$CL_{BL} < CL_{normal}$
$CL_n < CL_{normal}$

Therefore EF_{BL} was recalculated according to the AM0034 methodology requirements and in accordance with EB 51 Annex 12 “Clarification to AM0034 (Version 02): Catalytic Reduction of N_2O Inside the Ammonia Burner of Nitric Acid Plants”. The values were eliminated for the parameter $NCSG_{BC}$ beyond the length of CL_n for calculating mean values for $NCSG_{BC}$. The baseline emissions (BE_{BC}) were recalculated by using this mean value multiplied by the mean value of the volume of stack gas (VSG_{BC}) and total operating hours (OH_{BC}) of the baseline campaign. For recalculation of the EF_{BL} the nitric acid production (NAP_{BC}) corresponding to the total operating hours of the baseline campaign length (OH_{BC}) was used.

The end point of the baseline data selected for calculation of $NCSG_{BC}$ was 20.07.2008. 2:00 with the NAP equal to 291785.49 t HNO_3.

2.6 Impact of regulations

AB Achema operates according the IPPC permit No.2/15 which was updated on April 30 2008. The IPPC permit issued to AB Achema imposes two types of N_2O emission limits: total annual emission amount and onetime concentration values. Actual N_2O emissions have not exceeded annual emission limits stated in the IPPC permit, therefore the baseline was not affected by this type of limitation. However, annual limits starting from year 2011 are lower, which will affect the corresponding campaigns. This impact will be reflected in the related monitoring reports.

One time concentration value limits are set at 104.98 g/s (or 1400 ppmv) and does affect the baseline as these values are occasionally exceeded. All required adjustments are performed manually - NCSG values exceeding this limit are reduced to 104,98 g/s and applied in further calculations.

3. Monitoring results

3.1. Results of the baseline campaign calculation

EVALUATION OF BASELINE					
Begin		**05.09.2007 10:00**			
End		**28.07.2008 24:00**			
Permitted data ranges from PDD					
1 Burner	OT max	769.5	^{0}C		
	OT min	756	^{0}C		
2 Burner	OT max	778	^{0}C		
	OT min	764.1	^{0}C		
3 Burner	OT max	778.7	^{0}C		
	OT min	765.2	^{0}C		
4 Burner	OT max	777.2	^{0}C		
	OT min	761.4	^{0}C		
	OP max	284	kPa		
	OP min	243	kPa		
	AFR max	11497.16	kg/h		
	AFR min	9622.76	kg/h		
	AIFR max	10.1	%		
	AIFR min	9.3	%		
Gs Normal		Johnson Matthey			
Gc Normal		95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
Gs Baseline		Johnson Matthey			
Gc Baseline		95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
UNC		5.12	%		
OHBC total		7589	h		
OHBC in operation condition		5045	h	66.48	%
VSGBC (mean)		139039.58	Nm^3/h	5045	values
VSGBC (st. dev.)		6949.84	Nm^3/h		
VSGBC (mean 95 %)		139117.38	Nm^3/h	4826	values
NCSGBC (mean)		2631.85	mg/Nm^3	4980	values
NCSGBC (st. dev.)		166.33	mg/Nm^3		
NCSGBC (mean 95 %)		2640.18	mg/Nm^3	4776	values
NAPBC		**299803.81**	**t HNO_3**		
BEBC		**2787.401**	**t N_2O**		
EFBL		**0.008821**	**tN_2O / $tHNO_3$**		

Calculations of baseline emissions are presented in file
"*baseline calculation and evaluation V4.0. 11-02-2010*"

3.2. Results of the project campaign calculation

EVALUATION OF FIRST PROJECT CAMPAIGN				
Begin	17.08.2008 01:00			
End	26.09.2009 09:00			
Type	Project line			
Gs Normal	Johnson Matthey			
Gc Normal	95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
Gs Baseline	Johnson Matthey			
Gc Baseline	95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
Gs Project line	Johnson Matthey			
Gc Project line	95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
OH total	7677	h		
VSG (mean)	133902.72	Nm^3/h	7677	values
VSG (st. dev.)	10790.23			
VSG (mean 95 %)	133816.79	Nm^3/h	7422	values
NCSG (mean)	327.10	mg/Nm^3	7677	values
NCSG (st. dev.)	199.79			
NCSG (mean 95 %)	302.68	mg/Nm^3	7304	values
NAPn =CL1	**291805.31**	t HNO_3		
NAPn 2008 year	82257.62	t HNO_3		
NAPn 2009 year	209547.69	t HNO_3		
PEn	**310.9490**	t N_2O		
EFn=EFp	**0.001066**	tN_2O / $tHNO_3$		
EFBL	0.008821	tN_2O / $tHNO_3$		
ER 2008 (16.08.08-31.12.08)	**197761.52**	t CO_2		
ER 2009 (01.01.09-26.09.09)	**503788.83**	t CO_2		
ER total (16.08.08-26.09.09)	**701550.36**	t CO_2		

* Values of ER 2008 year and of ER 2009 year are rounded to 2 digits after coma, therefore is small deviation between sum of these figures (ER 2008 and ER 2009) and figure of ER total.

Calculations of first project campaign emissions are presented in file *“1st project line calculation and evaluation V5.0. 20-04-2010”*

3.3. Remarks

Calculated amount of ER in current monitoring period exceeds the amount estimated in the registered PDD due to 2 reasons:

1. higher efficiency of the secondary catalyst than projected
2. lack of precise N_2O concentration measurements at the pre-project phase

The projected efficiency of the secondary catalyst was at the level of 80% N_2O abatement. This figure was used as a conservative approach, based on the minimum efficiency guaranteed by the manufacturer. The actual efficiency during the project campaign has reached 88%.

In order to project N_2O emission reductions, a stationary analyser SICK-Mayhak UNOR 6N (infrared) was used to measure N_2O concentration in the tail gas flow in April 2007. At that time, measurement results gave short term average N_2O concentration of 2119,16 mg/Nm^3, which translated into 7,07 kg/$tHNO_3$. The actual concentration ($NCSG_{mean95\%}$) during the baseline campaign, after the proper monitoring was 2640 mg/Nm^3 and emission factor was 8,8 kg/tHNO$_3$. This resulted 21% lower projected ER compared to the actual ER of the 1st project campaign:

$ER = (EF_{Bl} - EF_P) * NAP_P * GWP_{N2O}$

$ER_{Projected} = (0.00707 – 0.001414) * 330000 * 310 = 578608.8$ t CO2

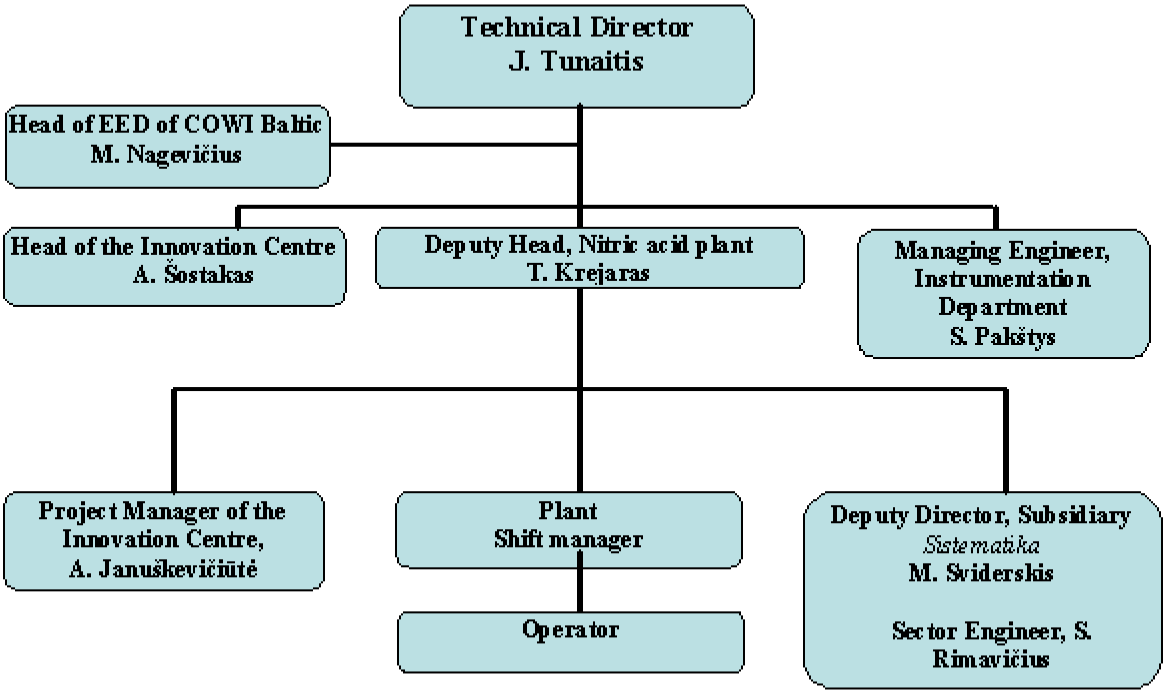
$ER_{Actual} = (0.008821 – 0.001066) * 291805.31 * 310 = 701550.36$ t CO2

* For projected emission reductions, EF_P was calculated based on projected efficiency of the secondary catalyst of 80% i.e. 20% of the projected EF_{Bl} which results in 0.001414.

** Projected emissions in the PDD were calculated on a yearly basis not for campaigns therefore comparison presented here is illustrative.

Since initial measurements back in 2007 were performed during only one week's time it is likely that the time was to short to precisely define emission values. Also, the purpose of the measurements at that time was to get some data in order to make a forecast for future project emissions but not to perform precise calculations. These reasons resulted in lower ER forecast than it proved to be the reality.

Annex I – scheme of responsibilities



The overall responsibility is represented by the Technical director of AB ACHEMA.

The monitoring process is under the responsibility of the Nitric Acid Plant Deputy Head. The description of these activities is provided in the JI Project Manual for GP Plant. This document is included in the plant quality management system and is available to the audit team.
The Nitric Acid Plant Deputy Head and Plant Shift Manager are responsible for data collection during the plant operation.

The monitoring data is processed, validated, adjusted, if necessary, and recorded. The Nitric Acid Plant Deputy Head is in charge of programming all formulae in the spreadsheets which are used for calculation. The Plant Shift Managers process the data, check the data for consistency, validate and record it every day in electronic and paper form. In case of failure of a monitoring equipment, staff of Subsidiary “Sistematika” is responsible for troubleshooting according to JI Procedures Manual “Troubleshooting Procedure”. The Nitric Acid Plant Deputy Head adjusts the data according to the JI Project Manual for GP Plant. In case the failure is not covered by the procedure, the Nitric Acid Plant Deputy Head makes the decision to correct the figures or to abandon the data.

The Nitric Acid plant Deputy Head is responsible for archiving the data. Data in electronic form is stored in EMI3000 system computer which contains two hard discs with mirror function (RAID0), additional data are stored in external hard disc drive, which is installed in remote control of GP department. Data collected in electronic form are printed from EMI 3000 system computer every day and are stored in GP department Head’s office (performed by Head of GP department). Both, original document and the backup file are kept up to 2 years after the end the project crediting period.

Additionally N2O monitoring system parameter data is collected in Foxboro system and at the end of the month is stored in data discs (DVD), which are stored in the room of Head Deputy of the Plant.
The N2O monitoring parameters via Foxboro system are observed by DVP operator of GP unit. In case of deviations from normal values DVP operator should inform GP unit chief operator and shift engineer. Shift engineer takes actions in order to eliminate malfunction.
Calculation and validation of emission reductions is done after each campaign by the Nitric Acid Plant Deputy Head.

The roles and responsibilities of other persons, which are represented in scheme, are provided below:

Head of the Energy and Environment department (EED) of “COWI Baltic” is responsible for preparation of monitoring reports.

The Managing Engineer of Instrumentation Department of AB ACHEMA is responsible for coordination of N2O monitoring-related issues.

The Deputy Director of Subsidiary “Sistematika” is responsible for the control of the maintenance of the monitoring system, compliance with the operation rules for measurement and automation instruments, and for the analysis of the monitoring system failures.

The Sector Engineer of Subsidiary “Sistematika” is responsible for assurance of correct operation of the monitoring system, for the arrangement of the compliance with QAL3 procedure, for preparation of manuals and internal maintenance procedures for the monitoring system, for keeping in touch with service providing organisations on the issues of monitoring system troubleshooting and maintenance.

The Head of the Innovation Centre is responsible for coordination of the JI-Project-involved departments, for collaboration with JI partners, for control of funds for JI Project and he is contact person with JISC.

The Project Manager of the Innovation Centre is responsible for arrangement of meetings, for conclusion of agreements, their coordination and fulfilment; he is also the contact person for project’s correspondence.

Annex II - Calibration procedures

For gas analyzers

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 15 months.	Laboratory of Metrology JS "Achema"

For volume flow transmitters

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 15 months.	Laboratory of Metrology JS "Achema"

For temperature converters

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 27 months.	Laboratory of Metrology JS "Achema"

For thermocouples and resistance thermometers

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 63 months.	Laboratory of Metrology JS "Achema"

For Pressure gauges with electrical output signal

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 15 months.	Laboratory of Metrology JS "Achema" (Accredited body)

For smart mass flow meters

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 51 months.	Laboratory of Metrology JS "Achema"

For smart pressure, pressure difference meters

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 51 months.	Laboratory of Metrology JS "Achema" (Accredited body)

For obstruction devices-orifice plates

QA/QC procedures	Body responsible for calibration and verification
a) measuring liquid flow ratio in aggressive media and technological gas flow ratio calibration interval is 87 months. b) measuring liquid flow ratio in aggressive media and steam flow ratio calibration interval is 63 months	Laboratory of Metrology JS "Achema" (Accredited body)

For smart level meters

QA/QC procedures	Body responsible for calibration and verification
Management procedure P-241-42 Calibration interval of such meters is 39 months.	Laboratory of Metrology JS "Achema"

Annex III - List of N2O monitoring system relevant measuring equipment in GP nitric acid plant

No.	Tag	Parameter measured	Measu-ring units	Device Type	Serial number	Passport number	Accuracy	Date of installation	Date of last calibration	Date of next calibration year/month/day	Calibration interval in months acc. to QC procedure P-241-42 "Control of metrology"
1	2	3	4	5	6	7	8	9	10	11	12
1.	AT08205	N_2O concentration in stack gas	ppm	Analyzer AO 2040/ URAS 26	3.344450.7	8-2180	1.0 % FS	2007	2009. 02.26	2010.02/	15
2.	FI08102	Volume flow of stack gas	mbar nm^3/h	Transmitter 26SDSCCF A6J1 Sampling probe DF25GR/ M2	265DS66000 10629-01	11-5808	0.25% FS 1.0 % FS	2007	2009. 01.06	2010.01/	15 -
3.	TT08103	Temperature of stack gas	^{o}C	Transmitter TP04ECO	502560	6-1616	1.0% FS	2007	2009. 01.05	2010.01/	15
				Resistance thermo-meter Pt100	Part of flow measure-ment DF25	9740	0.3+0.005x(t) ^{o}C	2007	2007.05.07	2012.05/	63
4.	PT 08102	Pressure of stack gas	bar abs	Transmitter DMU01ST	1055454	13-9023	0.5% FS	2007	2009. 01.07	2010.01/	15
5.	FT05201	HNO_3 production log	kg/h	Coriolis massflow-meter CMF300L4 91NAG2	410293	9-1380	0.1% of readings	2003	2006.09.12	-	51
					12035803	9-1641		2008	2008.10.20	2012.11/	51
6.	TT05201	Temperature of produced HNO_3	^{o}C	Transmitter PRETOP 5333A	030239348	6-1181	0.1% FS	2003	2009. 11.16	2011.11/	27
				Resistance thermo-meter Pt100		29-5201	0.3+0.005x(t) ^{o}C	2003	2007.05.12	2012.05/	63

1	2	3	4	5	6	7	8	9	10	11	12
7.	FT01302	NH_3 gas flow to the mixer	nm^3/h	Transmitter IDP10-A	03341837	11-5092	0.25% FS	2003	2007.09.04	2011.09/	51
				Orifice plate DK10-300	1051-300	31-1302	Deviation of orifice dimension not more than 0.02% from calculated value	2003	2008.08.11	2013.08/	63
8.	FT01302-1	NH_3 gas flow to the mixer	nm^3/h	Transmitter IDP10-A	03341838	11-5091	0.25% FS	2003	2007.09.05	2011.09/	51
9.	FT01302-2	NH_3 gas flow to the mixer	nm^3/h	Transmitter IDP10-A	03341836	11-5093	0.25% FS	2003	2007.09.07	2011.09/	51
10.	PT01103	NH_3 gas pressure before the mixer	kPa	Transmitter IGP20-D	03341844	13-8056	0.25% FS	2003	2007.09.04	2011.09/	51
11.	TT01302	NH_3 gas temperature before the mixer	°C	Transmitter PRETOP 5333A	030239274	6-1133	0.1% FS	2003	2009. 10.08	2011.10/	27
				Resistance thermometer Pt100		29-1302	$0.3+0.005x(t)$ °C	2003	2007.05.12	2012.05/	63
12.	FT02301	Air flow to the mixer	nm^3/h	Transmitter IDP10-A	03341839	11-5094	0.25% FS	2003	2007.09.05	2012.09/	51
				Orifice plate DB10-1100	1102	31-2301	Deviation of orifice dimension not more than 0.02% from calculated value	2003	2003.10.28	2010.10/	87
13.	FT02301-1	Air flow to the mixer	nm^3/h	Transmitter IDP10-A	03341840	11-5097	0.25% FS	2003	2008. 04.28	2012.04/	51
14.	FT02301-2	Air flow to the mixer	nm^3/h	Transmitter IDP10-A	03341841	11-5096	0.25% FS	2003	2007.09.05	2011.09/	51
15.	PT02301	Air pressure before the mixer	kPa	Transmitter IGP20-D	03341848	13-8048	0.25% FS	2003	2007.09.05	2011.09/	51

1	2	3	4	5	6	7	8	9	10	11	12
16.	TT02301	Air temperature before the mixer	°C	Transmitter PRETOP 5333A	030239333	6-1131	0.1% FS	2003	2008. 01.24	2010.01/	27
				Resistance thermometer Pt100		29-2301	0.3+0.005x(t) °C	2003	2007.05.12	2012.05/	63
17	FIQ106	HNO_3 flow from intermediate storage	kg/h	Transmitter IDP10-B	03341940	11-5070	0.25% FS	2003	2008.04.29	2012.04/	51
				Orifice plate DK10-125	1801-125	31-106	Deviation of orifice dimension not more than 0.02% from calculated value	2003	2009. 10.09	2014.10/	63
18.	LIAHL101	Level in HNO_3 storage F122A	%	Level transmitter BM-702	4/333817.001	10-1761	above 1m ± 1cm above 5m ± 0.2%	2003	2008.09.16	2011.09/	39
19.	LIAHL102	Level in HNO_3 storage F122B	%	Level transmitter BM-702	3/330.794.003	10-1762	above 1m ± 1cm above 5m ± 0.2%	2003	2008.09.26	2011.09/	39
20.	TT03004	Temperature in reaction zone A	°C	Transmitter T32.10.000	57D6400104581	6-1231	0..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.15	2011.10/	27
				Thermocouple type K		28-3004	-40..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.19	2014.10/	63
21.	TT03010	Temperature in reaction zone B	°C	Transmitter T32.10.000	57D6400104624	6-1218	0..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.15	2011.10/	27
				Thermocouple type K		28-3010	-40..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.15	2014.10/	63

1	2	3	4	5	6	7	8	9	10	11	12
22.	TT03017	Temperature in reaction zone C	°C	Transmitter T12.10.004	42419	6-1278	0.2% FS	2003	2009. 10.15	2011.10/	27
				Thermo-couple type K		28-3017	-40..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.15	2014.10/	63
23.	TT03024	Temperature in reaction zone D	°C	Transmitter T32.10.000	57D640010 4597	6-1229	0..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009. 10.15	2011.10/	27
				Thermo-couple type K		28-3024	-40..333 °C ±2,5 °C 333÷1200°C ±0,0075x (t) °C	2003	2009.10.15	2014.10/	63