JI Project

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

MONITORING REPORT

THIRD PROJECT CAMPAIGN

Monitoring period: from 12/07/2011 to 23/09/2012

Version 1.3

November 2012

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INTRODUCTION

The purpose of the Joint Implementation project "Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertilizer Factory" (hereinafter – the Project) is to reduce N_2O emissions from Achema GP nitric acid production plant by using secondary catalyst that converts N_2O into Oxygen (O_2) and Nitrogen (N_2). When implementing the Project there is no cause for greenhouse gas (hereinafter – GHG) emissions.

The Project started to be carried out by installing the secondary catalyst in August 2008 (a part of secondary catalyst was replaced in November, 2011). This monitoring report (hereinafter – the Report) covers the period of the third project campaign, when emissions have been monitored during the period from 12 of July, 2011, till 23 of September, 2012.

The Report contains information on emission reductions during above mentioned period and reviews steps, implemented in accordance with the Monitoring plan and the requirements of the CDM methodology AM0034 "Catalyst reduction of N_2O inside the ammonia burner of nitric acid plants" v02.

REFERENCE

- Approved baseline and monitoring methodology: CDM methodology AM0034 "Catalyst reduction of N_2O inside the ammonia burner of nitric acid plants" v02, available at http://cdm.unfccc.int/methodologies/DB/993RRDBB2WJI9TAD2XCKPK5YATQXY6.
- Determination of the JI-project "Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertilizer Factory". Report No. 1029455.
- JI Manual for GP Plant (V3.0 2011-12-16).
- Project Design Document "Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertilizer Factory".

1. DESCRIPTION OF THE PROJECT ACTIVITY

1.1. Brief description, registration date and related information

Project activity:	"Nitrous Oxide Emission Reduction Project at GP Nitric Acid Plant in AB Achema Fertilizer Factory, Lithuania"
UNFCCC registration number:	0064 (ITL-ID: LT2000005)
Project Participants:	AB ACHEMA
Location of the project:	Jonalaukis village, Rukla county, Jonava region municipality, Lithuania
Date of registration:	July 8, 2008 (date of Letter of Approval (LoA) issued by Host Party)
Starting date of the crediting period	August 16, 2008 (1^{st} project campaign)
Project campaigns	16/08/2008 – 26/09/2009 (1^{st} Project campaign) 25/01/2010 – 16/06/2011 (2^{nd} Project campaign) 12/07/2011 – 23/09/2012 (3^{rd} Project campaign)

BASF technology of catalytic destruction is used for reducing N_2O emissions from Achema GP nitric acid production plant by using secondary catalyst technology that converts N_2O into Oxygen (O_2) and Nitrogen (N_2). With this technology there is no cause for GHG emissions.

In order to calculate N_2O emission reductions from the project, ABB continuous multi-component measuring system Advance Cemas-NDIR is installed and operated.

1.2. Project participants

Host party – Lithuania

Legal entity, participating in the project - AB Achema

The Party involved does not wish to be considered as project participant.

AB Achema is a leading manufacturer of nitrogen fertilizers and chemical products in Lithuania and the Baltics. The company numbers over 1.4 thousand employees and annual fertilizer production is about 2 million tons. The plant production list consists of various items, such as nitrogen and compound fertilizers, adhesives, paints, resins, industrial gases, other chemical products and intermediates.

1.3. Location of the project activity

The Project is implemented in the territory of the AB Achema fertilizer factory, which is located in the central part of Lithuania near the Jonava town. The closest city Kaunas is situated about 30 km southwest from Jonava. Geographic coordinates of the factory site centre are: x=6105343 y=521432.

Figure 1. Geographical location of AB Achema fertilizer plant

1.4. Project boundary

The project boundary of the Project sets the limits of the Project from the perspective of calculating the emission reductions attributable to the project. Hence the project boundaries include all anthropogenic emissions by sources of GHG under control of the project participants.

N_2O emissions are the only attribute to the GHG source within the Project boundary. They are presented below:

Table 1. GHG source in the Project boundary

	Source	Gas	Included / excluded	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 CH4 emissions, therefore, these are not included
		CH_4	Excluded	
		N_2O	Included	
Project Activity	Nitric Acid Plant (Burner Intel to Stack)	CO_2	Excluded	The Project does not lead to any change in CO_2 or CH_4 emissions
		CH_4	Excluded	
		N_2O	Included	
	Leakage emissions from production, transport, operation and decommissioning of the catalyst.	C_2O	Excluded	No leakage emissions are expected
		CH_4	Excluded	
		N_2O	Excluded	

Project boundary covers entire GP plant, the diagram of it is presented bellow:

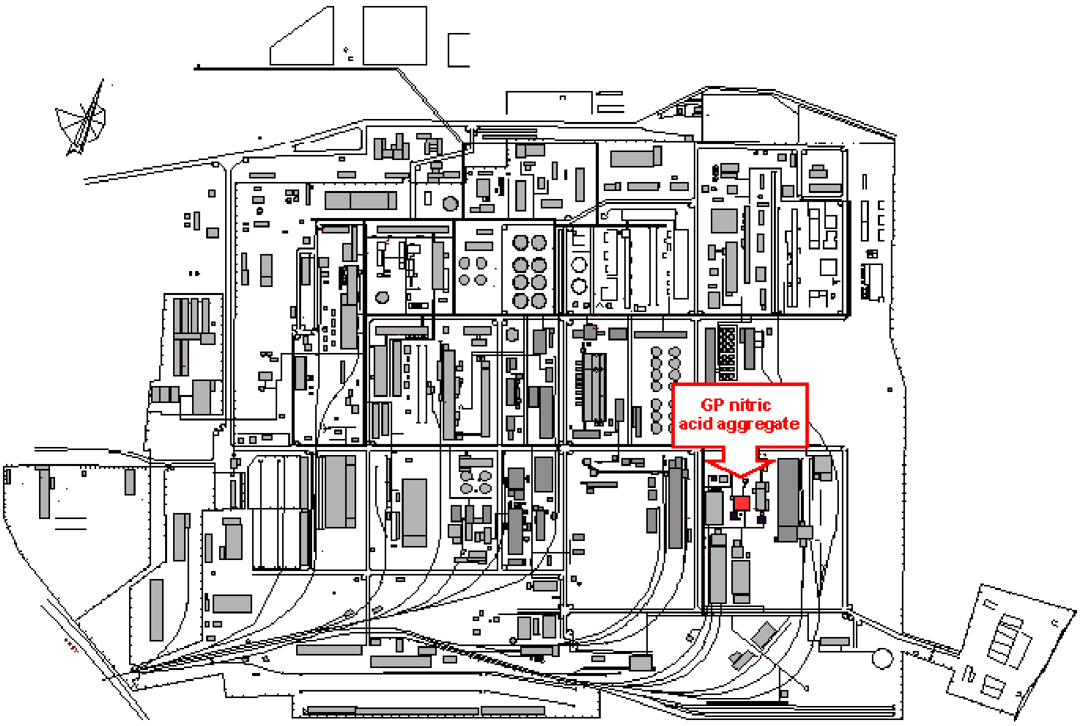


Figure 2. Location of the GP nitric acid plant within the fertilizer factory

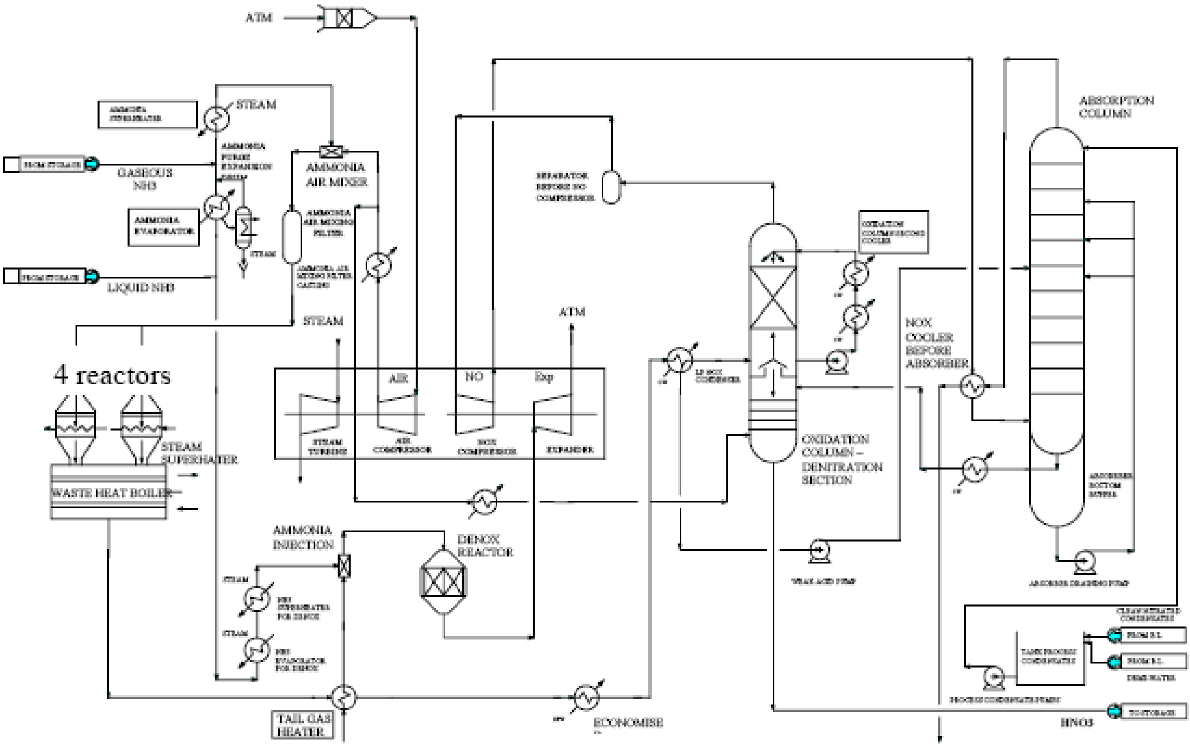


Figure 3. Nitric acid production scheme at GP plant

1.5. Technical description of the project

During the nitric acid (HNO_3) production process in nitric acid production plants, Nitrous Oxide (N_2O) is formed as a by product.

In order to produce nitric acid, ammonia (NH_3) is oxidized in a reactor with the precious metal (platinum-rhodium) catalyst gauzes into NO – desired product. NO then is oxidized to NO_2 which is absorbed in water to form HNO_3. N_2O, formed during the process is emitted to the atmosphere as a tail gas.

N_2O emissions reductions in GP nitric acid production aggregate are achieved by using secondary catalyst technology that converts N_2O into Oxygen (O_2) and Nitrogen (N_2). BASF technology is applied by introducing a new catalyst bed which is installed in a new basket, directly under Platinum gauze in the nitric acid reactors. The technology is owned and patented by BASF (German patent BASF Catalyst 03-85).

The secondary catalyst (on AL_2O_3 basis with active metal oxides CuO and ZnO) is installed underneath the platinum gauze. In order to be able to install a secondary catalyst before the first Project campaign, the reconstruction of a burner basket was been performed to make required 20-100 mm additional free space under the Platinum gauze.

The installation of the new basket, the secondary catalyst and the test of GP plant operation were successfully performed by August 17, 2008 before the plant started operating for the first project campaign.

At the end of the design operating life of primary catalyst gauze, the nitric acid plant was shut down. The primary catalyst was replaced by a new primary catalyst (new gauze pack). For the third project campaign the plant started to operate on July 12, 2011, and was stopped on September 23 at 07:00, 2012.

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 74 % in 2011 and 67 % in 2012 during the third project campaign.

2. DESCRIPTION OF THE MONITORING AND DATA PROCESSING SYSTEMS

2.1. Monitoring system

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

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.

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. This is the third project campaign (VIII).

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 4.

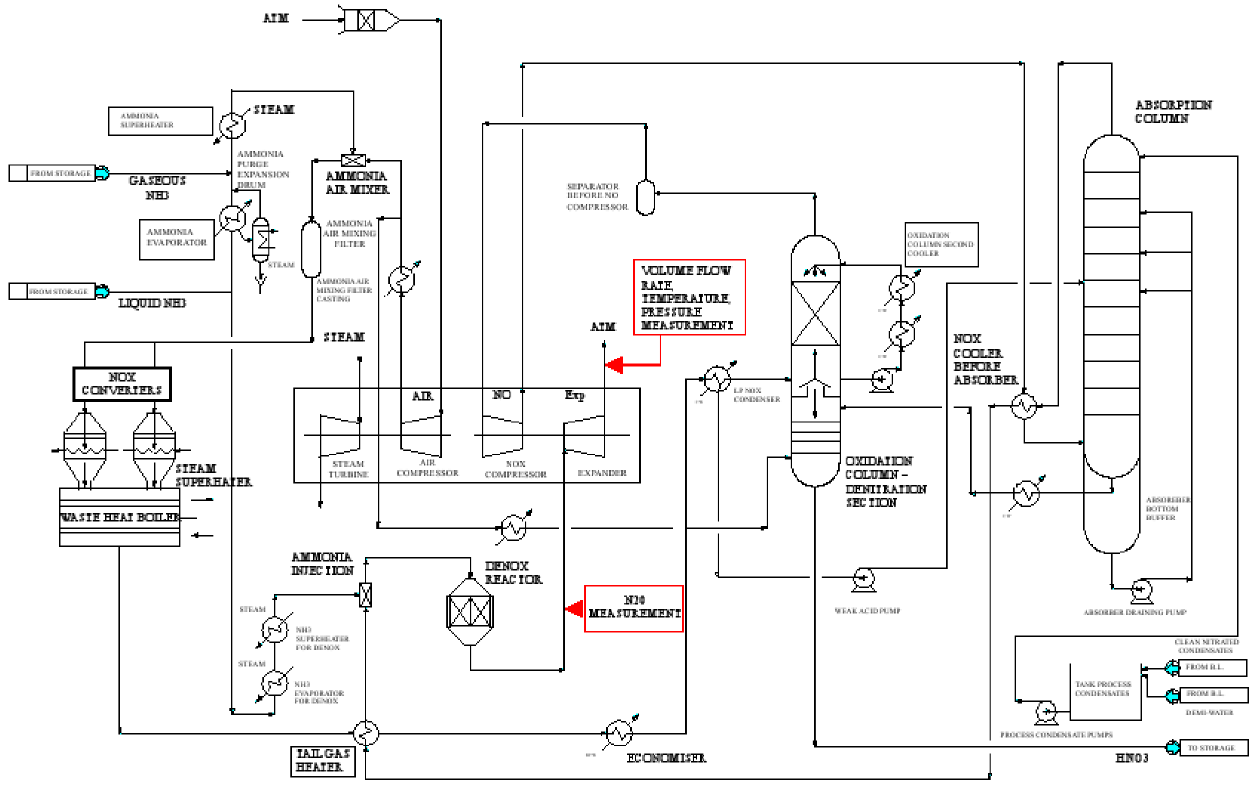


Figure 4. Sampling points for N_2O monitoring at GP plant

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:

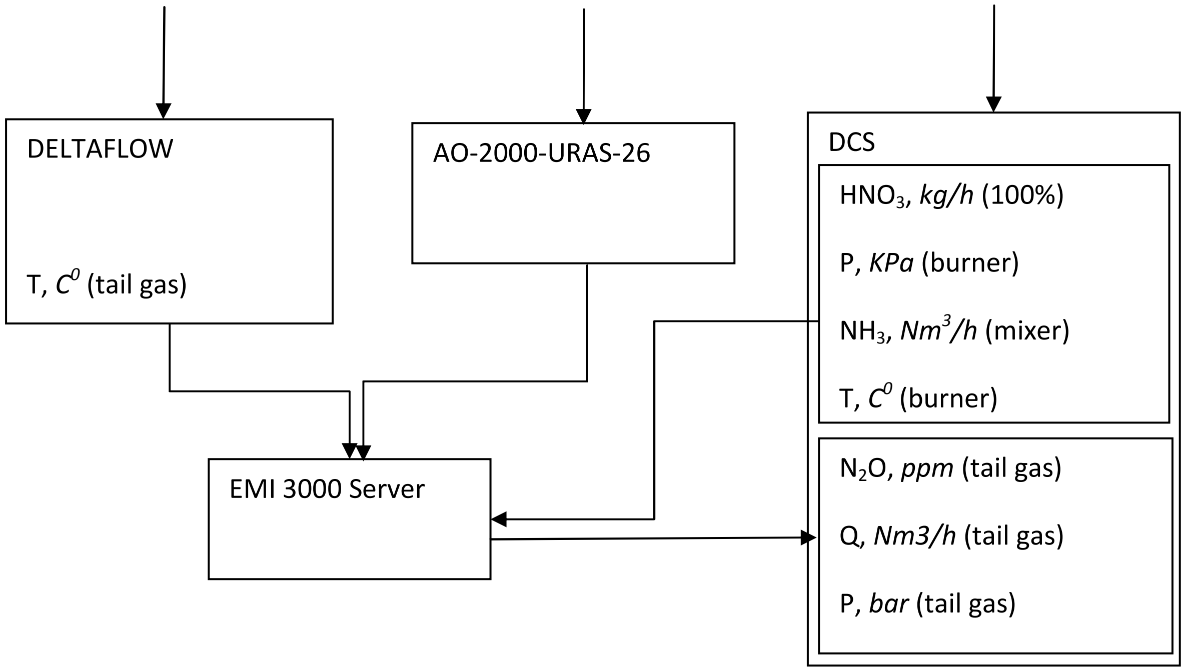


Figure 5. Automated monitoring system at GP plant

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 the openings required for QAL2 tests need to be made in the duct. QAL2 procedure is performed by an accredited independent entity.

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. According to the European Norm 14181, AST was performed for analyser by AIRTEC (ISO 17025 certified lab) on 19 of April, 2012.

From October 15 to October 17, 2011, QAL2 tests were performed for volume flow, pressure and temperature after the records of N_2O analyser had shown the exceeding of the N_2O calibration value due to lower efficiency of the secondary analyst. The tests results were adjusted into the system respectively.

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.

2.2. Data processing system

The data processing system consists of the following components:

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

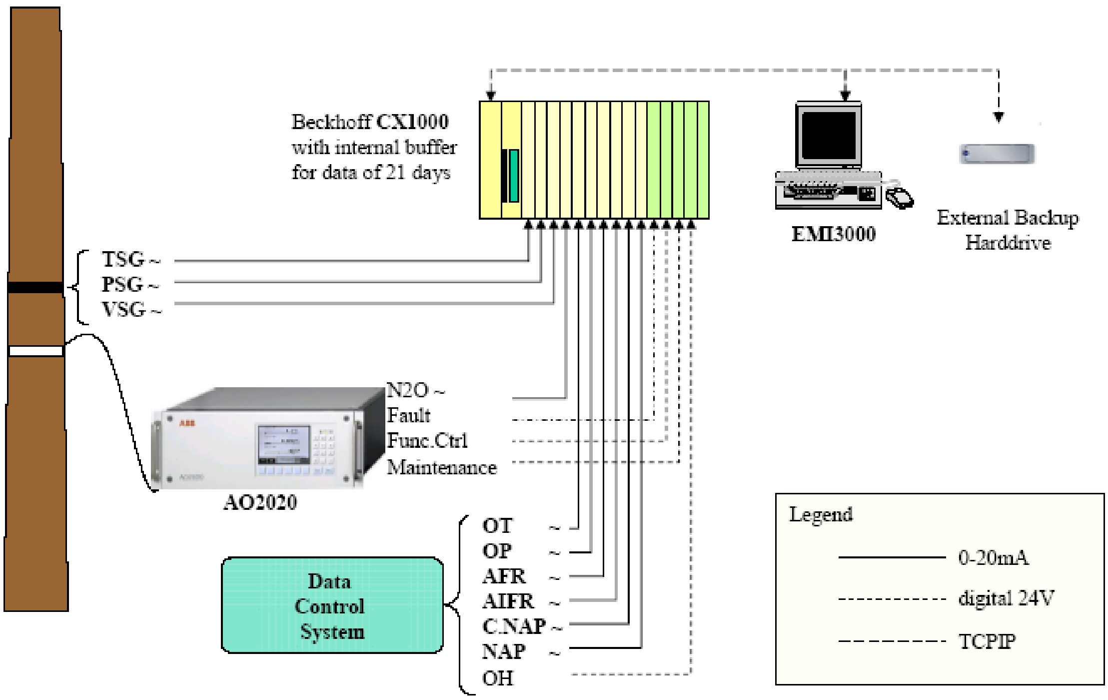


Figure 6. Data processing system

The Data logger CX1000 continuously reads and stores digital data of the monitoring system while EMI3000 handles the communication with the datalogger and continuously evaluates 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. The software is installed on the same PC running EMI3000 and is accessing its database. The software's compliance with AM0034 requirements has been verified and approved. EMI3000 and CDMN2O are operated by a responsible engineer of AB Achema while weekly maintenance and additional services related to the software are provided by AFRISO-EURO-INDEX GmbH.

All additional adjustments required by AM0034 and a verifier are performed manually in the excel sheets. The calculation files also serve as a basis for crosscheck of the monitoring accuracy.

Data processing system follows the methodology of the AM0034 and the monitoring plan, therefore only the final results as output of the system are presented in this report.

3. EVALUATION OF THE MONITORING DATA

3.1. Data and parameters monitored

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] N_2O concentration in tail gas Low Range
#NCSG[L] [s] N_2O Low Range: Valid Counter = incremented if in Low Range and valid
NCSG[H] [mg/m³] N_2O concentration in tail gas High Range
#NCSG[H] [s] N_2O High Range: Valid Counter = incremented if in high Range and valid
NCSG [mg/m³] N_2O concentration in tail gas
C(NAP) [%] Concentration of HNO_3
NAP (op) [t/h] HNO_3-Production
NAP [t/h] HNO_3-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 calculations are performed manually in excel sheets and are archived for the future reference.

In order to further ensure that operating conditions during the baseline campaign are representative of normal operating conditions, statistical tests have been performed to compare the average values of the permitted operating conditions with the average values obtained during the baseline determination period (comparisons are provided in the excel file "Statistical tests_V.1.0."). No differences in values are found, so the baseline determination should not be repeated.

3.2. Methodology

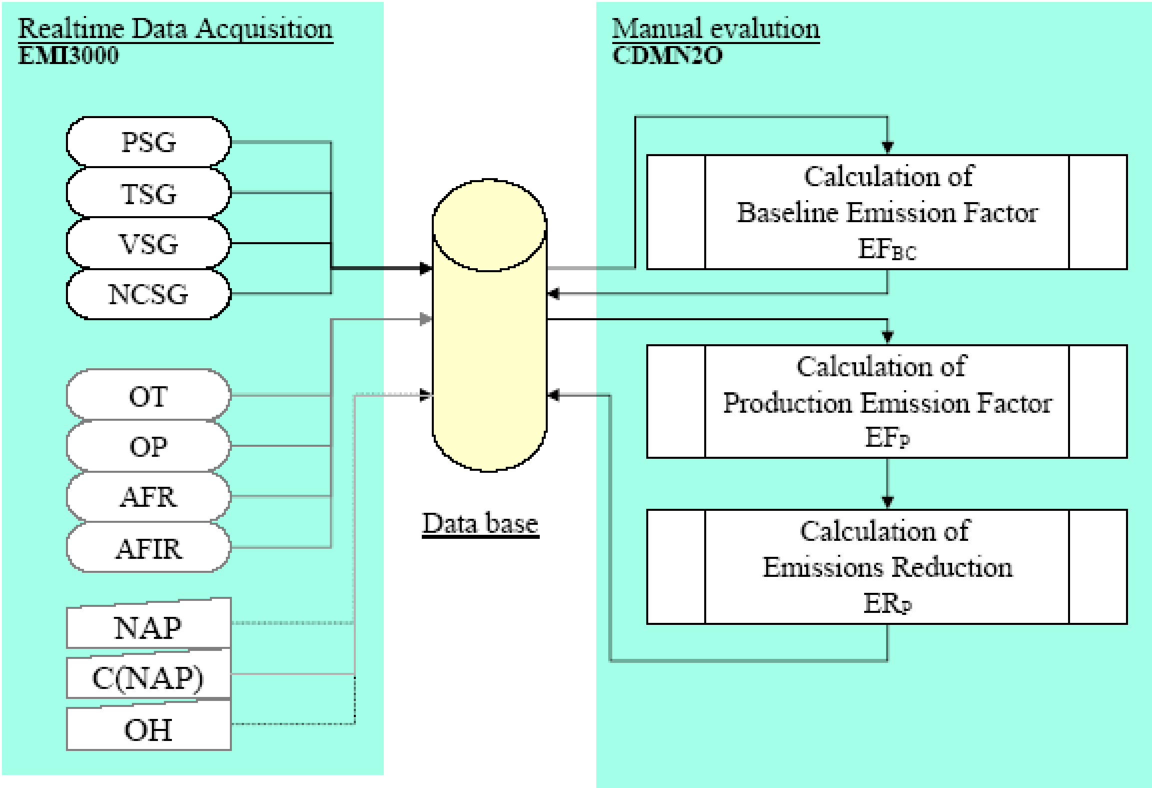


Figure 7. Data evaluation process

General evaluation rules are as follows:

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

$OT_{min} < OTh < OT_{max}$
$OP_{min} < OPh < OP_{max}$
$AFR_{min}<AFR < AFR_{max}$
$AIFR_{min}<AIFR < AIFR_{max}$

- 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 normalize VSG, PSG (hPa) and TSG (°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 H_2O/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 insignificant error it is not necessary to consider the water content in the calculation of the N_2O 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 AFR_{min} 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:
$\mathbf{ER = (EF_{BL} - EF_{p}) * NAP_{p} * GWP_{N2O}}$
$\mathbf{ER_p}$ = campaign specific emission reduction [t CO_2]
$\mathbf{EF_{BL}}$ = N_2O Baseline Emission Factor [t N_2O / t HNO_3]
$\mathbf{EF_p}$ = N_2O Production Emission Factor [t N_2O / t HNO_3]
$\mathbf{NAP_p}$ = HNO_3 production during Production campaign [t HNO_3]
$\mathbf{GWP_{N2O}}$ = constant 310 [t CO_2 / t N_2O]

The intermediate calculation is as follows:

1. Calculation of Baseline Emissions

$\mathbf{BE_{BC}} = \mathbf{VSG_{BC,95\%}} * \mathbf{NSCG_{BC,95\%}} * 10^{-9} * \mathbf{OH_{BC}}$ [t N_2O]
BE_{BC} = N_2O Baseline Emissions [t N_2O]
$VSG_{BC,95\%}$ = average stack flow inside 95%-confidence interval [Nm^3/h]
$NSCG_{BC,95\%}$ = average N_2O-concentration inside 95%-confidence interval [mg/Nm^3]
OH_{BC} = operating hours [h]

2. Calculation of Baseline Emission Factor

$\mathbf{EF_{BL}} = \mathbf{BE_{BC}} / \mathbf{NAP_{BC}} * (1 - \mathbf{UNC} / 100\%)$ [t N_2O / t HNO_3]
EF_{BL} = N_2O Baseline Emission Factor [t N_2O / t HNO_3]
BE_{BC} = N_2O Baseline Emissions [t N_2O]
NAP_{BC} = HNO_3 Production during campaign [t HNO_3]
UNC = total uncertainty of system [%]

3. Calculation of Campaign Emissions

$\mathbf{PE_n} = \mathbf{VSG_{n,95\%}} * \mathbf{NSCG_{n,95\%}} * 10^{-9} * \mathbf{OH_n}$ [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

$\mathbf{EF_n = PE_n / NAP_n}$ [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]

5. Derivation of a moving average emission factor

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

$EF_n = PE_n / NAP_n$ t (N_2O / t HNO_3)

Step 2
Moving average emissions factor is calculated at the end of a campaign "n" as follows:

$EF_{ma,n} = (EF_1+EF_2+........EF_n) / n$ (N_2O / t HNO_3)

The maximum of $EF_{ma, n}$ and EF_n is considered for estimation of project emissions.

3.3. 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. All data handling during these periods is described in the JI manual for GP plant, which is used by the personnel of the plant as a reference.

3.4. 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} = 299.803,81 t HNO_3
CL_{normal} = 303.129,33 t HNO_3
CL_n = 350.239,45 t HNO_3

$CL_n > CL_{normal}$ and $CL_{BL} < CL_{normal}$, so it is not necessary to recalculate EF_{BL}.

3.5. Impact of regulations

IPPC regulation and N_2O inclusion into the EU Emission Trading Scheme has to be taken into account when considering consistency with mandatory laws and regulations.

AB Achema operates according to the IPPC permit No 2/15. The permit was revised on April 30, 2008. It sets two kinds of N_2O emission limitations: total yearly emission amount and one time concentration values. Allowable emissions of N_2O indicated in the IPPC permit is 2926 t in 2011 and 2040,5 t in 2012 (respectively 96,76 g/s in 2011 and 67,48 g/s in 2012). A comparison of calculated N_2O emissions and permitted emissions according to the IPPC permit limitations in the 3rd Project campaign is done by using EF_{BL} value.

Therefore in the period of the 3rd Project campaign, yearly GP Nitric Acid Plant's emissions of N_2O are lower than permitted emissions stated in the IPPC permit in 2011, but higher than permitted emissions stated in the IPPC permit in 2012. Moreover, a comparison is performed using an emission limit value indicated in IPPC permit related to a certain year and baseline campaign data. Emission factors in 2012 derived from the regulatory limit in both ways are lower than EF_{BL}. The lowest of them is chosen as the most conservative approach shall be used.

As stated in the methodology AM0034, if the regulatory limit is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline factor, that is:

If $EF_{BL} > EF_{reg}$
where:
EF_{BL} – N_2O baseline emission factor ($tN_2O/tHNO_3$)
EF_{reg} – emissions level set by IPPC permit ($tN_2O/tHNO_3$).

Then the baseline N_2O emission factor shall be EF_{reg}.

According to the data of 3rd Project campaign:
For the year 2011:
EF_{BL} = **0,008533** $tN_2O/tHNO_3$
EF_{reg} = 0,011 $tN_2O/tHNO_3$

For the year 2012:
EF_{BL} = 0,007206 $tN_2O/tHNO_3$
EF_{reg} = **0,006659** $tN_2O/tHNO_3$

So EF_{reg} shall be used as the new baseline factor for the calculation of emission reduction of 3rd Project campaign in 2012, however EF_{BL} remains a baseline emission factor for 2011.

During the 3rd Project campaign (in 2011 and 2012), N_2O is not included into the EU Emission Trading Scheme. However the Project activity considering this consistency will be affected from 2013.

4. MONITORING RESULTS

4.1. Results of the baseline campaign calculations

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	11.497,16	kg/h		
	AFR min	9.622,76	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	%		
OH_{BC} total		7.589	h		
OH_{BC} in operation condition		5.045	h	66,48	%
VSG_{BC} (mean)		139.039,58	Nm^3/h	5045	values
VSG_{BC} (st. dev.)		6.949,84	Nm^3/h		
VSG_{BC} (mean 95 %)		139.117,38	Nm^3/h	4826	values
$NCSG_{BC}$ (mean)		2.563,64	mg/Nm^3	4980	values
$NCSG_{BC}$ (st. dev.)		167,77	mg/Nm^3		
$NCSG_{BC}$ (mean 95 %)		2.554,01	mg/Nm^3	4793	values
NAP_{BC}		**299.803,81**	**t HNO_3**		
BE_{BC}		**2.696,431**	**t N_2O**		
EF_{BL}		**0,008533**	**t N_2O / tHNO_3**		

Calculations of baseline emissions are presented in file "*baseline calculation and evaluation V.5.1. 23-10-2012*". It should be noted that the emission limit values stated in the IPPC permit for 2011 is reflected in this evaluation of baseline campaign.

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	11.497,16	kg/h		
	AFR min	9.622,76	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	%		
OH_{BC} total		7.589	h		
OH_{BC} in operation condition		5.045	h	66,48	%
VSG_{BC} (mean)		139.039,58	Nm^3/h	5045	values
VSG_{BC} (st. dev.)		6.949,84	Nm^3/h		
VSG_{BC} (mean 95 %)		139.117,38	Nm^3/h	4826	values
$NCSG_{BC}$ (mean)		2.155,69	mg/Nm^3	4980	values
$NCSG_{BC}$ (st. dev.)		443,05	mg/Nm^3		
$NCSG_{BC}$ (mean 95 %)		2.156,64	mg/Nm^3	4793	values
NAP_{BC}		**299.803,81**	**t HNO_3**		
BE_{BC}		**2.276,899**	**t N_2O**		
EF_{BL}		**0,007206**	**t N_2O / tHNO_3**		

Calculations of baseline emissions are presented in file "*baseline calculation and evaluation V.5.2. 23-10-2012*". It should be noted that the emission limit values stated in the IPPC permit for 2012 is reflected in this evaluation of baseline campaign.

4.2. Results of the project campaign calculations

EVALUATION OF PROJECT CAMPAIGN No. 3				
Begin	12.07.2011 22:00			
End	23.09.2012 07:00			
Type	Project line			
Status	Calculated			
Gs Normal Gc Normal Gs Baseline Gc Baseline Gs Project line Gc Project line	Johnson Matthey 95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4) Johnson Matthey 95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4) Johnson Matthey 95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)			
OH total	9.617	h		
VSG (mean)	129.082,81	Nm^3/h	9.511	values
VSG (st. dev.)	11.322,54			
VSG (mean 95 %)	129.055,39	Nm^3/h	9.410	values
NCSG (mean)	614,88	mg/Nm^3	9.582	values
NCSG (st. dev.)	190,88			
NCSG (mean 95 %)	614,88	mg/Nm^3	9.582	values
NAP_n total	350.239,45	t HNO_3		
NAP_n 2011 year	126.711,67	t HNO_3		
NAP_n 2012 year	223.527,78	t HNO_3		
PE_n	763,142	t N_2O		
EF_n	0,002179	tN_2O / $tHNO_3$		
EF_{BL} (used for ER in 2011)	0,008533	tN_2O / $tHNO_3$		
EF_{BL} replaced by EF_{reg} used for ER in 2012	0,006659	tN_2O / $tHNO_3$		
ER 2011 (12.07.11-31.12.11)	249.611,71	t CO_2		
ER 2012 (01.01.12-23.09.12)	310.469,18	t CO_2		
ER total (12.07.11-23.09.12)	**560.081**	t CO_2		

Calculations of 3[rd] Project campaign emissions are presented in file *"3rd project line calculation and evaluation V.3.0. 2012-11-06"*

* Values of ER 2011 year and of ER 2012 year are rounded to 2 digits after coma, therefore is small deviation between sum of these figures (ER 2011 and ER 2012) and figure of ER total.

5. EMISSION REDUCTION CALCULATIONS

5.1. Baseline emissions and N_2O emission limit from IPPC regulation

For year 2011:
BE_{BC} = 139.117,38 * 2.554,01 * 10^{-9} * 7.589 = 2.696,431 t N_2O
EF_{BL} = 2.696,431 / 299.803,81 * (1 – 5,12 / 100%) = 0,008533 t N_2O / t HNO_3

For year 2012:
BE_{BC} = 139.117,38 * 2.156,64 * 10^{-9} * 7.589 = 2.276,899 t N_2O
EF_{BL} = 2.276,899 / 299.803,81 * (1 – 5,12 / 100%) = 0,007206 t N_2O / t HNO_3
EF_{reg} = 2040,5 * 267 / 366 / 223.527,78 = 0,006659 t N_2O / t HNO_3

5.2. Project emissions

PE_n = 129.055,39 * 614,88 * 10^{-9} * 9.617 = 763,142 t N_2O

EF_n = 763,142 / 350.239,45 = 0,002179 t N_2O / t HNO_3

EF_1 = 0,001066 t N_2O / t HNO_3
EF_2 = 0,001404 t N_2O / t HNO_3
EF_n = 0,002179 t N_2O / t HNO_3
$EF_{ma,n}$ = (0,001066 + 0,001404 + 0,002179) / 3 = 0,00155 tN_2O / t HNO_3

If $EF_{ma,n} < EF_n$, then EF_n is used for further calculations of project emission reductions.

5.3. Illustration of emission reduction calculations

ER_{2011} = (0,008533 - 0,002179) * 126.711,67 * 310 = 249.611,71 t CO_2
ER_{2012} = (0,006659 - 0,002179) * 223.527,78 * 310 = 310.469,18 t CO_2
ER = ER_{2011} + ER_{2012} = 249.606,12 + 310.459,32 = 560.080,89 t CO_2

5.4. Remarks

The above calculated amount of emission reductions was generated during the monitoring period of the 3rd Project campaign from July 12, 2011, till September 23, 2012 (440 days).

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 2.119,16 mg/Nm^3, which translated into 7,07 kg/tHNO_3. The actual concentration ($NCSG_{mean95\%}$) during the revised baseline campaign was 2.643,65 mg/Nm^3 and emission factor was 8,8 kg/tHNO_3. IPPC permit limitation has an impact on the emission reduction results of 3rd Project campaign. Emission factor derived from IPPC permit regulation is lower than EF_{BL} and is used instead of it in the calculation of emission reduction in 2012. Nevertheless, ER_{Actual} is very close (3,2 %) to the $ER_{Projected}$.

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

$ER_{Projected} = (0,00707 – 0,001414) * 330.000 * 310 = 578.608,8$ t CO_2
$ER_{Actual} = (0,008533 - 0,002179) * 126.711,67 * 310 + (0,006659 - 0,002179) * 223.527,78 * 310 = 560.080,89$ t CO_2

For projected emission reductions, EFP 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 tN_2O/ $tHNO_3$.

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.

Projected emissions in the PDD were calculated on a yearly basis not for campaigns. Therefore a campaign length does not correspond with a calendar year.

The 3rd Project campaign took place 440 days, which resulted in NAP equal to 350.239,45 t HNO_3 (126.711,67 t HNO_3 in 2011 and 223.527,78 t HNO_3 in 2012). Rated capacity of nitric acid production which is stated in the IPPC permit is 350.000 t per year. According to the actual data, total NAP in 2011 is 264.959.27 t HNO_3 (NAP data of 2nd project campaign is included for the calculation of NAP in 2011). Moreover, calculation of comparative values of actual NAP and rated capacity stated in the IPPC permit considering the operation time of the plant during each year is performed. Consequently, actual NAP does not exceed the rated capacity of NAP during 3rd Project campaign.

Annex I – AM0034 configuration with 2010 QAL2

ACHEMA Jonova, Line 1

004 Production (12.07.11 22:00 - 23.09.12 07:00)

Date: 10/9/2012
Page: 1

Configuration 01

Campaigne Data				Minimum	Maximum
Type	: project	OT	:	0.00 °C	1000.00 °C
Status	: calculated	OP	:	0.00 kPa	1000.00 kPa
Start	: 12.07.2011 22:00	AFR	:		20000.00 t NH3/h
Stop	: 23.09.2012 07:00	AIFR	:		15.00 %
UNC	: 5.12 %				
Cl.Normal	: 303129.330 t				
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	: Johnson Matthey				
GC.Project	: 95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)				

			Range [min]		Range [max]		Gradient		Zero-Offset		Std.Deviation		Factor
			low	high	low	high	low	high	low	high	low	high	
NCSG	[F1] NCSG[L].IR	post calc.	0.000	980.000	-0.010	3920.150	62.09	248.36	-248.37	-993.48	5	5	1
VSG.oc	[F1] VSG.opcond	post calc.	0.000	218506.000	-	-	14858.8	0	-59435.1	0	0	0	1
PSG	[F1] PSG	post calc.	0.000	1600.000	-	-	100.2	0	-400.81	0	0	0	1
TSG	[F1] TSG	post calc.	0.000	400.000	-	-	25.04	0	-100.17	0	0	0	1
VSG.1.oc		none	-	-	-	-	-	-	-	-	-	-	1
PSG.1		none	-	-	-	-	-	-	-	-	-	-	1
TSG.1		none	-	-	-	-	-	-	-	-	-	-	1
VSG.2.oc		none	-	-	-	-	-	-	-	-	-	-	1
PSG.2		none	-	-	-	-	-	-	-	-	-	-	1
TSG.2		none	-	-	-	-	-	-	-	-	-	-	1
OH	[F1] Op.Time	direct	-	-	-	-	-	-	-	-	-	-	1
OT	[F1] OT	direct	-	-	-	-	-	-	-	-	-	-	1
OP	[F1] OP	direct	-	-	-	-	-	-	-	-	-	-	1
AFR	[F1] AFR	direct	-	-	-	-	-	-	-	-	-	-	1
AIFR	[F1] AIFR	direct	-	-	-	-	-	-	-	-	-	-	1
C[NAP]	[F1] C[HNO3]	post calc.	0.000	100.000	-	-	0	0	100	0	0	0	1
NAP(op)	[F1] NAP.Input	direct	-	-	-	-	-	-	-	-	-	-	0.001

Annex II – AM0034 configuration with 2012 QAL2

ACHEMA Jonova, Line 1

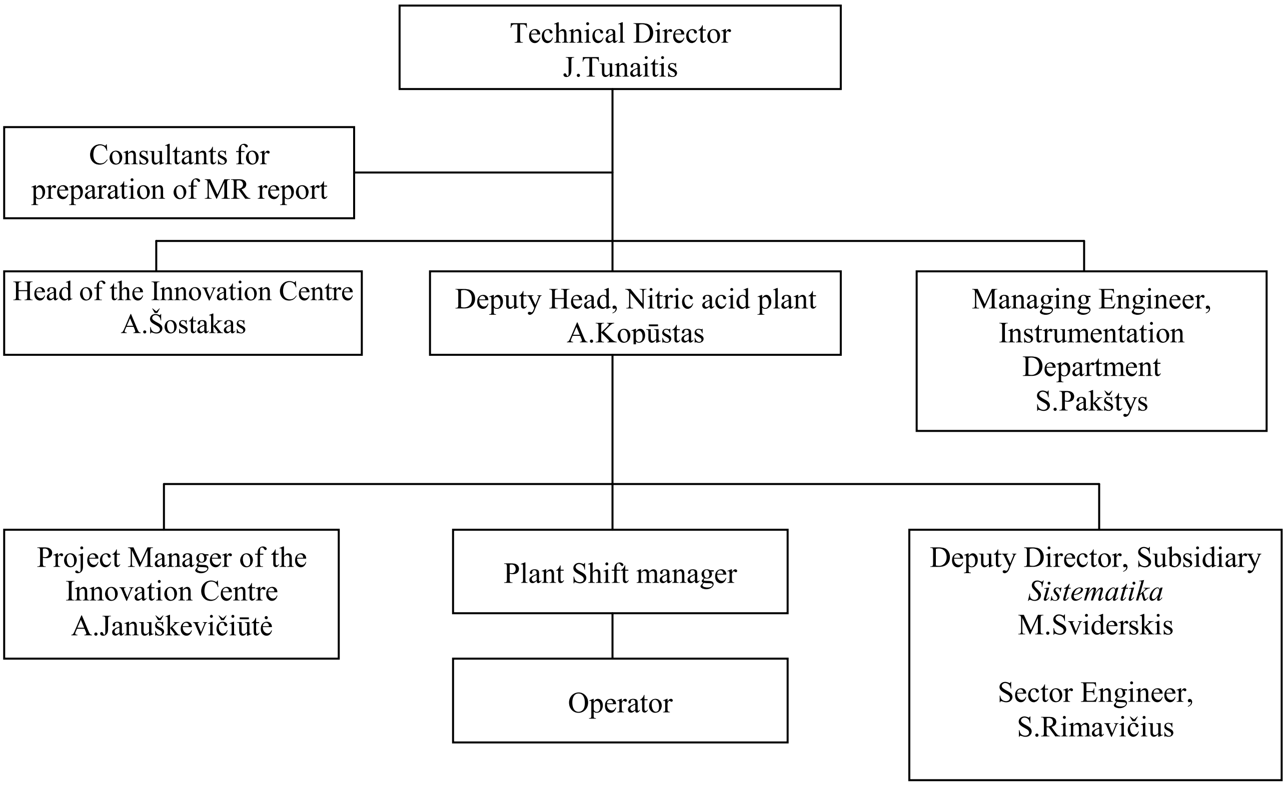
004 Production (12.07.11 22:00 - 23.09.12 07:00)

Configuration 02

Campaigne Data				Minimum	Maximum
Type	: project	OT	:	0.00 °C	1000.00 °C
Status	: calculated	OP	:	0.00 kPa	1000.00 kPa
Start	: 12.07.2011 22:00	AFR	:		20000.00 t NH3/h
Stop	: 23.09.2012 07:00	AIFR	:		15.00 %
UNC	: 5.12 %				
Cl.Normal	: 303129.330 t				
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	: Johnson Matthey				
GC.Project	: 95% Pt/5%Rh (Gauze 1-3), 37%Pt/60%Pd/3%Rh (Gauze 4)				

			Range [min]		Range [max]		Gradient		Zero-Offset		Std.Deviation		Factor
			low	high	low	high	low	high	low	high	low	high	
NCSG	[F1] NCSG[L].IR	post calc.	0.000	980.000	-0.010	3920.150	61.31	245.24	-245.24	-980.96	2	2	1
VSG.oc	[F1] VSG.opcond	post calc.	0.000	218506.000	-	-	14858.8	0	-59435.1	0	0	0	1
PSG	[F1] PSG	post calc.	0.000	1600.000	-	-	100.2	0	-400.81	0	0	0	1
TSG	[F1] TSG	post calc.	0.000	400.000	-	-	25.04	0	-100.17	0	0	0	1
VSG.1.oc		none	-	-	-	-	-	-	-	-	-	-	1
PSG.1		none	-	-	-	-	-	-	-	-	-	-	1
TSG.1		none	-	-	-	-	-	-	-	-	-	-	1
VSG.2.oc		none	-	-	-	-	-	-	-	-	-	-	1
PSG.2		none	-	-	-	-	-	-	-	-	-	-	1
TSG.2		none	-	-	-	-	-	-	-	-	-	-	1
OH	[F1] Op.Time	direct	-	-	-	-	-	-	-	-	-	-	1
OT	[F1] OT	direct	-	-	-	-	-	-	-	-	-	-	1
OP	[F1] OP	direct	-	-	-	-	-	-	-	-	-	-	1
AFR	[F1] AFR	direct	-	-	-	-	-	-	-	-	-	-	1
AIFR	[F1] AIFR	direct	-	-	-	-	-	-	-	-	-	-	1
C[NAP]	[F1] C[HNO3]	post calc.	0.000	100.000	-	-	0	0	100	0	0	0	1
NAP(op)	[F1] NAP.Input	direct	-	-	-	-	-	-	-	-	-	-	0.001

Annex III – 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 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 N_2O 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 N_2O 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, by the consultants or by their assistance. In two latter cases all calculations are reconciled with the Nitric Acid Deputy Head.

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

Consultants prepare Reports and corresponding calculations of emission reductions and explanation sheets, which are reconciled with the Nitric Acid Deputy Head.

The Managing Engineer of Instrumentation Department of AB ACHEMA is responsible for coordination of N_2O 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 fulfillment; he is also the contact person for project's correspondence.