

APPENDIX A

DNV GL references flue gas cleaning

SO2 covenant 2014-2015

Customer(s):

Country: Netherlands Year: 2016

Project value: EUR DNV GL value: EUR 51500

As part of the SO2 covenant between coal based power producers and the Dutch government there is an obligation to independently monitor the SO2 emission and emission performance. DNV GL performs this independent monitoring for Energie-Nederland by collecting the participant's data each three months in an (anonymous and confidential) report. The emission performances are compared with the period's predictions and the emission ceiling. Annually the emission data are accumulated and combined with updated predictions reported in a document that Energie-Nederland delivers to the Dutch Ministry.

Fact-based scenario to meet commitments under the LCP BREF

Customer(s): European Climate Foundation

Country: Netherlands Year: 2016

Project value: EUR DNV GL value: EUR 79000

The European Climate Foundation (ECF) is looking for a fact-based scenario to identify technical requirements imposed on the hard coal/lignite fired large combustion plants (LCPs) by the Industrial Emission Directive (IED) and the revised Best Available Techniques (BAT) Reference Document for Large Combustion Plants (LCP BREF) and to estimate the investment costs of the required measures.

In 2017 an update of the LCP BREF will be issued. The BAT-conclusions of this LCP BREF have to be implemented in national regulations by 2021. This means that as of 2021 LCPs shall comply with the BAT-conclusions of the LCP BREF.

NOx reduction of heat boilers

Customer(s): Eneco Warmteproductie Utrecht BV

Country: Netherlands Year: 2016

Project value: EUR DNV GL value: EUR 16400

De client owns several heat boilers that are not compliant with the Dutch requirements for the emission of NOx, as of the 1st of January 2017. The heat boilers have forced draught burners, and are fueled by natural gas. To be able to maintain the boilers, the boilers will need to be compliant with the new emission compliance levels as stipulated in the Dutch Activiteitenbesluit. Therefore, the client had started a tendering procedure for refurbishment of the boilers to make them compliant with the emission requirements.

Optimization of a flue gas desulphurization unit at a large coal fired power plant in Brazil.

Customer(s):

Country: Brazil Year: 2014

Project value: EUR 15000 DNV GL value: EUR 15000

The project consisted of the optimization of a flue gas desulphurization plant at a large coal fired unit, suffering from serious operational problems and emission values exceeding the limits.

AST-, QAL2- and CO-measurements and functional testing of the emission monitoring systems of several furnaces and the Swentibold CHP in the years 2005-2010

Customer(s): EdeA; Royal DSM; SABIC Europe Netherlands
Country: Netherlands Year: 2011
Project value: EUR 178400 DNV GL value: EUR 178400

Many different types of company and industries are based at Chemelot, ranging from base chemicals to fine chemicals, companies producing raw materials to companies developing new products and start-ups to multinationals. The Chemelot industrial estate is located in the south of the Netherlands.

The Client is responsible for the operation and maintenance of several furnaces and one CHP plant at the Chemelot estate for the production of power, heat and water for the operating companies.

Since 2005 KEMA performs AST-, QAL2- and CO-measurements and functional tests at several installations of the Client. It concerns seven furnaces, two nitric acid factories and one CHP-plant. This work is being performed within the framework of the BEES, NO_x-monitoring and trade, and the environmental license for which the installation need to possess a monitoring protocol according to the Ministry's Program of Requirements. This means that one provides transparency concerning the real emitted volume of NO_x. This is quantification is done by means of AST- and QAL2-measurements and calculations. Besides, several furnaces have been modelled in KEMA's performance monitoring program ThermoWare, enabling the online calculation of emission data based on the incoming signals of the monitoring equipment. For the Swentibold CHP one has chosen for the calculation of the NO_x emissions by means of a PEMS instead of a CEMS which requires monitoring equipment.

Annual PEMS and CEMS checks for Yara in Sluiskil according to the NEN-EN 14181 2006-2010

Customer(s): Yara Sluiskil
Country: Netherlands Year: 2011
Project value: EUR 217300 DNV GL value: EUR 217300

According to the change amendment BEES A installations with a thermal power output of over 100 MWth have to continuously measure their NO_x emissions. This continuous measurement may also be based on the continuous measurements of the combustion plant parameters of determined emission characteristics. According to the BEES A and the Clarification Memorandum annual testing of these emission characteristics is required according to the NEN-EN 14181.

Purpose of the emission measurements is to support Yara, especially their power and heat producing units, in the process of the Emission Trading Scheme (ETS). Therefore, KEMA performs the calibration and annual check measurements of the existing unit monitoring instrumentation (CEMS or PEMS) of these units.

PEMS: Predictive Emission Monitoring System

CEMS: Continuous Emission Monitoring System

Performing biannual PEMS checks 2005-2010 at several installations of AVEBE

Customer(s): AVEBE
Country: Netherlands Year: 2011
Project value: EUR 120400 DNV GL value: EUR 120400

Since 2005 KEMA performs, by order of AVEBE, comparative NO_x-measurements, QAL-2 and AST, at three gas turbines according to the NEN-EN 14181 standard. The measurements are being performed at GT35 in Foxhol (biannual), CHP3 in Ter Apelkanaal (biannual) and at GT10 in Gasselternijveen (biannual). At the same time BEES measurements are being performed at the CHP1 in Ter Apelkanaal. The measurements are being performed to check AVEBE's Predictive Emission Monitoring Systems (PEMS) with respect to the annual emission reporting and emission trading schemes.

Annual emission measurements at several units of the Total Refinery in Flushing for the period 2004-2010

Customer(s): Total Raffinaderij Nederland
Country: Netherlands Year: 2011
Project value: EUR 137900 DNV GL value: EUR 137900

In 1970 Total starts the construction of the refinery in Flushing. The refinery starts operation in 1973. In 1986 they start the hydro cracker process for the production of sulphur free fuels. In 2009 Dow Chemicals transfers its shares to Lukoil. From that time the refinery is a JV of Total (55%) and Lukoil (45%). Annually, the refinery processes 7 million tonnes of crude oil and 2.5 million tonnes heavy fuel oil from other refineries.

By order of TRN, KEMA performs the annual emission measurements at several units of the refinery for the benefit of the environmental license to operate, the annual environmental report, the Periodic Emission Monitoring System (PEMS) and the CO₂ and NO_x trading schemes.

At the end of 2005 KEMA submitted a PEMS for a reformer furnace, validated and calibrated it according to the NEN-EN 14181 guideline and the Program of Requirements.

Emission measurements at the 400 MWe coal fired unit 12 of the Borssele power plant for the period 2009-2011

Customer(s): Elektriciteits-Produktiemaatschappij Zuid-Nederland
Country: Netherlands Year: 2011
Project value: EUR 73300 DNV GL value: EUR 52100

EPZ ordered KEMA to perform emission measurements at several installations with respect to the environmental legislation for the Borssele coal fired power plant. All measurements, analysis and reporting will be done in accordance with the guidelines written in the :

- BEES A
- BVA
- emission license NO_x/CO₂

- Wm-license
- IPPC-guideline
- NEN-EN 14181
- NEN-EN 15259.

In 2007 KEMA performed extensive guarantee measurements at the unit at the end of a large life time extension program.

Technical assistance in procurement activities and development of NOx and SO2 reduction techniques.

Customer(s): JP Elektroprivreda
 Country: Bosnia and Herzegovina; Netherlands Year: 2010
 Project value: EUR 300000 DNV GL value: EUR 230000

Technical assistance to the Project Implementation Unit of a client in Eastern Europe in procurement activities and study to develop the design of NOx and SO2 emission reduction at their brown coal fired thermal power plants (TPP),

considering the current situation with regard to:

- the emissions,
- legal obligations,
- obligations to the Energy Community Treaty
- and relevant European regulations up to the year 2025.

Performance tests of the 2 • 300 MWe coal fired Pego power station in Portugal after the Flue Gas Desulphurization and Selective Catalytic Reduction extension

Customer(s): Tejo Energia
 Country: Portugal Year: 2010
 Project value: EUR 91700 DNV GL value: EUR 91700

The existing two coal fired PEGO Power Plants of Tejo Energia Portugal, have been modified recently, each with a Flue Gas Desulphurization (FGD) and Selective Catalytic Reduction (SCR) extension. According to the agreements between the generator Tejo Energia and the purchaser REN, the additional operating costs of the extension needs to be adjusted and implemented in the existing invoice system. In an amendment agreement of the PPA of 2007, the specific definitions for the determination of the new technical consumptions and operating conditions are specified. KEMA is requested to perform the performance tests, with the purpose to determine and to provide the related parameters. KEMA will act as an independent engineer on behalf of Tejo Energia and REN. As part of the scope of work the exact methods for the determination of the parameters will be defined in specific test procedures and to be agreed upon by both parties.

Consequences of combustion of LNG at the UCML Power Station

Customer(s): E.ON Benelux Generation

Country: Netherlands Year: 2010

Project value: EUR DNV GL value: EUR 40000

It is envisaged that the composition of the natural gas that is fired at the UCML Power Station will change in the near future. This is caused by the construction of a LNG terminal at the Maasvlakte.

The client has asked KEMA to evaluate the consequences for the UCML Power Station with respect to emission and operational issues and to support the client in discussions with the gas supplier and equipment supplier.

Annual QAL-2 and AST measurements at the three gas turbines of AES Elsta in Hoek 2005-2010 for the benefit of the environmental legislation and emission trading schemes

Customer(s): AES Electric Division, ELSTA Site

Country: Netherlands Year: 2010

Project value: EUR 77600 DNV GL value: EUR 77600

AES Elsta is a 630 MWe gas-fired, combined cycle cogeneration facility in the Netherlands based on three GE MS9001E gas turbines. Since commercial operations began in 1998, the plant has provided energy to some of the largest employers in the region of Zeeland, a province located in the southwest part of the country that is mostly under sea level. Dow Benelux is one of the largest local employers in the area and is also a major customer of AES Elsta.

Since 2005, by order of AES Elsta, KEMA performs each year the QAL-2 and AST measurements according to the NEN-EN 14181 standard at the three gas turbines of AES Elsta in Hoek, the Netherlands.

Condition Monitoring of Six Furnaces Using ThermoWare for the Calculation of the Annual NOx-emissions

Customer(s): EdeA; SABIC Europe Netherlands

Country: Netherlands Year: 2010

Project value: EUR 66400 DNV GL value: EUR 66400

The NOx-emissions of the several furnaces at the Client are being calculated by means of the KEMA monitoring program ThermoWare. The emissions are being calculated on monthly basis from hourly averaged measured data. The NOx-emissions are calculated as a function of supplied fuel flow and measured emissions. Because the furnaces are also fired with offgas the energy flow is calculated on basis the supplied energy and boiler heat balance according to the DIN 1942. ThermoWare extracts the measured data from the unit instrumentation via the unit DCS-system.

In 2010 KEMA has been asked to adapt the performance monitoring model of F3500 and F3501 after the refurbishment with LowNOx burners and flue gas recirculation.

Continuous Emission Monitoring Plan and Services for Enecogen

Customer(s):

Country: Netherlands Year: 2010

Project value: EUR 18600 DNV GL value: EUR 18600

The Enecogen power plant is a partnership of Eneco and DONG Energy and is currently being built in the Rotterdam Europort area. This gas-fired power plant will have a power output of 870 MW and will be equipped with a DeNOx installation to minimize NOx emissions. For this plant Enecogen needs an emission license and a CO2 and NOx monitoring plan. This monitoring plan has to fulfil all requirements according to the "Regeling Monitoring Handel in Emissierechten" and the requirements in the environmental licence of Enecogen. The monitoring plan has to be submitted to the Dutch Emission Authority (NEa) for approval and obtaining the emission licence. Secondly, the CO2 and NOx monitoring plan needs also be submitted to the DCMR Milieudienst Rijnmond accompanied by an additional monitoring plan for CO and NH3. As a third point Enecogen wants to ensure that the annual emission report is well-underpinned and will be accepted without any problems by NEa after verification. For these successive "after care services" KEMA is required to deliver support.

Environmental Impact Statement and licence application for the retrofit of the existing WtE plant from SCR-DeNOx to SNCR.

Customer(s): Attero Noord, Locatie Wijster

Country: Netherlands Year: 2010

Project value: EUR DNV GL value: EUR 84000

KEMA submitted the Environmental Impact Statement (EIS) and the required licence applications for the retrofit of the existing WtE plant from SCR-DeNOx to SNCR.

The impact of installing wall rings in the FGD unit at EPZ BS12 power station

Customer(s): Elektriciteits-Produktiemaatschappij Zuid-Nederland

Country: Netherlands Year: 2010

Project value: EUR DNV GL value: EUR 25000

EPZ and its permitting authorities are aiming at a further emission reduction of SO2 from the BS12 power station. In an earlier study by KEMA multiple technical modifications have been identified as potential options for further emission reduction. One of these options is installing wall rings in the FGD scrubber. In this study the technical feasibility of installing wall rings and the expected impact on SO2 emissions has been assessed. Further, the cost effectiveness of this measure (EUR/ton SO2 not emitted) has been identified.

Assessment of operational health & safety aspects of the flue gas desulphurization (FDG) unit at Sines power station

Customer(s): Electricidade de Portugal

Country: Netherlands; Portugal Year: 2010

Project value: EUR 19500 DNV GL value: EUR 19500

At the EDP coal fired power station in Sines a flue gas desulphurization (FGD) plant has been put in operation in 2008.

Employees had complained about health & safety aspects of this new plant.

EDP ordered KEMA to provide them with an independent report on the H&S aspects of the plant.

Updating the Monitoring Plans for the New Emission Trading Period 2008-2012

Customer(s): Nuon Power, Heat & Services

Country: Netherlands Year: 2009

Project value: EUR 105000 DNV GL value: EUR 105000

With respect to the CO₂ and NO_x emission trade the Client submitted monitoring protocols. For the second trading period from 2008-2012 new emission licenses will be granted. One of the conditions for a license is the possession and use of an approved CO₂ and NO_x monitoring plan. In the new plants, at least, the new rules for CO₂-monitoring have to be adapted. Besides, the Clients wants to have clear and comparable emission trading procedures for all production facilities.

Technical feasibility of NO_x emission reduction for low-stack industrial sources

Customer(s): Dienst Centraal Milieubeheer Rijnmond

Country: Netherlands Year: 2009

Project value: EUR DNV GL value: EUR 88000

By order of DCMR the possibilities for the reduction of the emission of NO_x have been studied for three locations in the Rijnmond-area. The study belongs to the "Rotterdam action program air quality" and is part of 34 aimed measures for 5 different sectors (road traffic, shipping traffic, households and industry) in order to improve the air quality in the Rotterdam area. The units are close to residential areas or have an effect on the air quality as a result of their low stacks.

Study for the Sustainable Improvement of the CO₂ Balance of the Heat and Electricity Generation of Stadtwerke Chemnitz AG

Customer(s): Stadtwerke Chemnitz

Country: Germany Year: 2009

Project value: EUR DNV GL value: EUR 16000

Within the context of the study, possible measures for the improvement of the CO₂ balance of the electricity and heat generation and distribution were studied and assessed. The investigations contain the energetically analysis of the existing structure of the heat and electricity generation, the determination of the possible efficiency reserves and the CO₂ reduction potential through substitution measures. The investigated measures can be divided into four categories: Substitution of energy sources and generation facilities Changing the mode of operation Increasing efficiency measures Measures in the electric power supply All measures were energetically balanced considering the expected retroactive effects on the existing generation and supply structure. Their CO₂ reduction potential was weighted and the acceptance by the public was assessed. The measures were then ranked for a deeper analysis and suggested for a second study phase.

Technical support of NEa (the Dutch Emission Authority) for the processing of notices, monitoring plans and the project ToVer-2008

Customer(s): Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer
Country: Netherlands Year: 2009
Project value: EUR 500000 DNV GL value: EUR 118200

The Dutch Emission Authority (NEa) has been appointed as the Dutch organization to supervise the compliance of businesses with the CO₂ and NO_x emission trade. The NEa comprises an operating office and the departments Validation & License, Supervision & Enforcement and Registration Emission Trade.

The department Validation & License is responsible for the treatment and review of license applications and amendment applications. The most important subject regarding the licensing concerns the monitoring of emissions. The departments capacity is suited for the processing of a number of amendments in a 'steady-state' situation. For the coming years, it is expected that the capacity will be insufficient to process all applications and reporting adequately. These reasons are:

- the number CO₂ emission trade participants for the second period (2008-2012) will increase significantly
- the recent changes in the 'Monitoring and Reporting Guidelines' of the European Commission
- because monitoring is at the beginning of the 'learning curve' for many businesses, many monitoring protocols are being adjusted.

For the second period (2008-2012), 130 plants participate in the CO₂ emission trade, 80 plants in the NO_x emission trade and 145 plants in both trading schemes.

Royal Haskoning is the project manager and vocal point for this assignment.

Non-destructive testing of the steam drum and inspections of the linings and coatings of the flue gas desulphurization unit and the cooling water channels of the 500 MWe coal-fired unit of the E.ON Maasvlakte power plant in Rotterdam

Customer(s): E.ON Benelux Generation
Country: Netherlands Year: 2009
Project value: EUR 100000 DNV GL value: EUR 100000

This project concerns a postponed maintenance stop, originally planned for the autumn of 2008. It concerns the periodically inspection program to be performed on the steam drum of unit 2, in the spring of 2009, based on a (new) foreseen inspection regime. With respect to the maintenance schemes of other components, one does not focus on three or four years' inspection intervals anymore, but on inspections every two years. By turn this will be an "A"-inspection program (extended stop), and a "B"-inspection. E.ON planned an A-inspection program for early 2009 for unit EFM2.

With respect to previous inspection programs, the present one also comprises UT spot checks of the steam drum and the studs and bends in the raisers on top of the steam drum.

Annual DeSOx-scrubber inspections from 2007-2009 of the coal fired power plant Langerlo in Belgium

Customer(s): E.ON Benelux Generation
Country: Belgium Year: 2009
Project value: EUR 30800 DNV GL value: EUR 30800

The Electrabel Langerlo power plant consists of two coal fired units and is the first power plant in Belgium to be equipped with SCR (DeNOx) and FGD (DeSOx). A third stack was built for the wet FGD flue gases. The two old stacks are emergency bypass only.

Evaluation of the NOx emission at a powder drying tower

Customer(s): Abbott Laboratories B.V.
Country: Netherlands Year: 2009
Project value: EUR DNV GL value: EUR 30000

In 2008 a new heater was installed to heat the process air for the powder drying tower of the client.

It appeared that the NOx emission was higher than expected.

The question was raised whether the installation was still BAT proof.

In the project an inventory was made in order to assess whether BAT was correctly applied.

Review of scenarios which are applied in the modelling for air quality as underpinning for future European policy

Customer(s): Dutch Power Generating Companies
Country: Netherlands Year: 2006
Project value: € 16300 DNV GL value: € 16300

As part of the European Commission's 6th Environmental Action Program (EAP), the so-called CAFE program evaluates the NEC Directive and the air quality directives in 2005. Outcomes of the evaluation include: - the introduction of new target values for PM2.5 - the introduction of an emission ceiling for PM2.5 - revision of the emission ceilings for SO2, NOx, NMVOS and NH3. The RAINS model is often used for both studies of European policy and for the definition of such policy. For the Dutch power generating companies KEMA executes in 2005: - gathering of information concerning model input - review of assumptions and scenarios used in the RAINS modelling - conveniently arranging of information - testing to other relevant data.

Determination of the air quality around the air ports "De Peel", "Volkel" and "Woensdrecht"

Customer(s): Nationaal Lucht- en Ruimtevaartlaboratorium
Country: Netherlands Year: 2006
Project value: EUR 25500 DNV GL value: EUR 25500

For the benefit of the Dutch air quality targets and the Air Quality Bill (2005) KEMA will deliver the following results for an area of 10 x 10 km around the airports "Eindhoven", "De Peel" and "Woensdrecht": - the maximum annual averaged concentration of NOx, NO2, CO, Benzene, PM10, VOS,

PAK and Lead - the number of exceeding days/hours of NO₂, SO₂, and PM₁₀ - the 98-percentile of CO and VOS.

Performance improvement of the flue gas cleaning installation of the municipal waste incineration line 2 of ARN in Weurt

Customer(s): Afvalverwerking Regio Nijmegen
Country: Netherlands Year: 2006
Project value: EUR 33200 DNV GL value: EUR 33200

ARN noted that since the maintenance stop of line 2 in April 2005 the flue gas cleaning installation of this line under performed resulting in a higher SO₂ emission in relation to the emission before the maintenance stop. Although the number of violation of the SO₂ limits was limited, the Authorities ordered ARN to bring back the SO₂ emissions back to the "old" level.

Extension of the KEMA TRACE model with a plant specific module for SO₂, HCl and HF removal

Customer(s): Dutch Power Generating Companies
Country: Netherlands Year: 2005
Project value: € 44900 DNV GL value: € 44900

The calculation model TRACE is being used for the benefit of the modeling of the behavior of elements from coal and biomass in pulverized coal fired power plants. Using TRACE it is possible –based on a certain fuel mix- to model and predict the emissions into the air and the composition of bottom ash and fly ash. TRACE is being used within the sector for calculations for the license to operate. Based on the TRACE history the model is also suitable to support plant operations and supporting decisions for yes or no for co-firing of certain secondary fuels. At this moment, by order of the Dutch power generating companies, TRACE is being extended to a broader model for operation support named CoFiringControl. In the present CoFiringControl models (and also within TRACE) removal of SO₂, HCl and HF from the flue gasses are calculated with fixed percentages, only depending on the presence or not of a reheater in the flue gas cleaning installation. This is also desired for the benefit of the license to operate as this handles averaged emission values in the long term. However, this is not sufficient for operational support. In practice the desulphurization efficiency depends on the flue gas flow, SO₂ concentration in the flue gasses and the pH of the washing suspension.

Prediction of the SO₂ Distribution at the Tripod Location in Unit 3 of the Eggborough Power Plant

Customer(s): British Energy Generation
Country: United Kingdom Year: 2005
Project value: EUR 8100 DNV GL value: EUR 8100

Prediction of the SO₂ Distribution at the Tripod Location in Unit 3 of the Eggborough Power Plant.

APPENDIX B

CV's of team members

CURRICULUM VITAE

Jan Middelkamp

Project Manager/Senior Consultant

Personal statistics

Citizenship: Dutch

Date of birth: Sep 13, 1966

Language capabilities

Language	Speaking	Reading	Writing
English	Good	Good	Good
German	Good	Good	Basic
Dutch	Excellent	Excellent	Excellent

Academic and professional attainment

Field of expertise	University/School	Year
Certificate "Chemical Engineering Process Design"	Twente University of Technology, 2nd phase training course "Process Design"	Aug 1989 - Jul 1991
MSc Chemical Engineering	Twente University of Technology, Faculty of Chemical Engineering	Aug 1983 - Jul 1989
Atheneum	Secondary Modern School GCSE A'levels	Sep 1977 - Jul 1983

Summary of professional experience

Mr. Jan Middelkamp is a project manager / senior consultant with over 25 years of experience in power generation. He is a specialist in flue gas cleaning and biomass (co-)firing.

His flue gas cleaning experiences include R&D activities, client engineering support during the construction of flue gas cleaning facilities, trouble shooting and optimization of existing flue gas cleaning systems as well as due diligence studies. These activities have been executed at electrical power plants, waste incineration plants and industrial facilities.

Jan has been the project manager of multiple of biomass co-firing and full-conversion feasibility studies, in several European countries as well as in the US. The scope of these projects included a technological economic assessment of different biomass co-firing and repowering options at large coal-fired units. Further biomass related experiences include feasibility studies on small scale biomass plants in developing countries.

Based on his broad experiences in the power generation and waste incineration sector, he has been involved in multiple feasibility and technical due diligence studies during the last 5 years.

Publications and papers

1. J. Middelkamp, Identification of bottlenecks for co-firing and full coal to biomass conversion at large power stations, IEA Clean Coal Workshop on Biomass Co-firing, Jun 20, 2013
2. J. Middelkamp, The future of co-firing, IEA Clean Coal Workshop on Biomass Co-firing, Mar 27, 2012
3. J. Middelkamp; K. Sullivan, Co-firing of biomass in the US, Presented at the WEI – 2009 Operations Conference, Long Beach, CA, USA, Apr 03, 2009
4. J. Middelkamp, Co-firing experience in the Netherlands, Presented at the EXXPERTS Conference in Brussels, Belgium, Oct 09, 2008
5. J. Middelkamp, NOx emission reduction in the Netherlands, Presented at Modern Power Systems, London, United Kingdom, May 24, 2005
6. J. Middelkamp, Effects of the Addition of Adipic Acid to a Limestone-Gypsum FGD-Installation, Presented at Power-Gen Europe '95, Amsterdam, the Netherlands, May 18, 1995
7. J. Middelkamp, Influence of Aluminium and Fluoride on the Limestone Reactivity in a Wet-Limestone-Gypsum Flue Gas Desulphurisation Process, Presented at the 1995 EPRI/EPA/DOE SO2 Control Symposium, Miami, FL, USA, Mar 28, 1995

Professional training

Year	Institute	Description
1992 - 2017	PBNA, Coach&Commitments, Bureau Zuidema, TSM Business School, Insight Organisation, Huthwaite	Several courses in the areas of Safety, Project Management and Commerce

Other information

project management; program management;

Employment record

DNV GL **Jan 1992 - Jun 2017**

Position: Principal Consultant

- R&D Engineer / Consultant / Project Manager / Senior Consultant (in Legacy KEMA)
- Project manager / Principal Consultant (in Legacy DNV GL)

Twente University **Jan 1990 - Dec 1992**

Position: Post Graduate

- Employed at Twente University to carry out research projects within the "Second Phase" post-graduate program

Detailed professional experience

Dutch utility, Netherlands, Emission reduction studies resulting from environmental permit, Jan 2017 - Jun 2017

Position: Project manager, Senior Consultant

Description: Dutch environmental permits for coal fired power plants include the obligation to regularly study options for further emission reduction. Relevant flue gas components include SO₂, NO_x, dust and trace elements, including mercury. For selected flue gas components suggestions are made to further reduce emissions to air.

Activities performed: Review of current operations performance, identification of techniques for further emission reduction, evaluation of techniques on suitability and effectiveness, support in discussions with competent authorities.

Confidential, Netherlands, Technical and environmental due diligence study, Apr 2016 - Aug 2016

Position: Senior Consultant

Description: A technical and environmental due diligence study has been performed on a European power utility. The results have been integrated with the financial and legal due diligence activities performed by other consultants.

Activities performed: Evaluation of data room, meetings with representative of power utility, meetings with legal and financial consultants, reporting.

Confidential, Netherlands, Review of engineering document, Mar 2016 - Nov 2016

Position: Project manager, Senior consultant

Description: Engineering documents for a biomass co-firing facility of a large coal fired power station have been reviewed and commented on. Results have been discussed with the client and modifications have been implemented in the final design documents.

Activities performed: Review of engineering documents, provide suggestions for improvement, discuss results with client.

European Commission, FP7, Belgium, HiPerCap, Jan 2016 - Jun 2017

Position: Senior Consultant

Description: Technology assessment, benchmark & comparison of different novel carbon capture processes on environmental impact, energy performance and investment & operational costs

Activities performed: DNV GL is responsible for the methodology development, execution of the methodology, providing guidance for technology developers and for benchmarking & comparing of all technologies

Engie, Netherlands, Improving the performance of a large flue gas desulphurization (FGD) plant, Dec 2015 - Jun 2017

Position: Senior consultant

Description: Based on a structured analysis of the operational date of the FGD plant and an inspection of the plant, options for improving plant performance have been advised to the client. Implementation hereof has been started by the client immediately.

Activities performed: Evaluation of operational data and laboratory analyses, inspection of the scrubber internals, meetings with plant personnel, reporting.

Confidential, Netherlands, Buyer due diligence on a large European waste to energy utility, Dec 2015 - Feb 2016

Position: Senior consultant

Description: The assessment included a technical economic assessment of a large number of waste to energy facilities, aiming at identifying "hidden" costs and risks that impact the overall business case for the transition of the assets.

Activities performed: Evaluation of operation data on waste feed and pre-treatment, waste combustion, environmental & compliance and byproducts. Site visits to collect additional operational experiences and data. Reporting.

Belize Electricity Limited (BEL), Netherlands, Feasibility of a bagasse fired power plant in Belize, Jun 2015 - Feb 2016

Position: Senior Consultant

Description: An independent power producer (IPP) considers the construction of a bagasse fired power plant in Belize. DNV GL supports BEL in their discussions with the IPP on technical and financial aspects of the project, including power plant technical aspects, business case, power purchase agreement (PPA).

Activities performed: Evaluation of power plant design, OpEx and CapEx; evaluation of business case and projected cost of electricity; support on drawing of PPA document.

Confidential, [confidential], Feasibility study for a new combined cycle power plant in South-East Asia, Jun 2015 - Sep 2015

Position: Deputy project manager, Senior Consultant
Description: Asian utility is considering to build a new combined cycle power plant to meet future power demand. Activities include the delivery of a Basis Of Design and a Conceptual Design Package report to support the client in selecting an optimal CCGT plant configuration.

Activities performed: Preparation of a Basis Of Design and a Conceptual Design Package report.

Confidential, [confidential], Assessment of full coal to biomass conversion design documents., May 2015 - Aug 2015

Position: Project manager, Senior consultant
Description: Client considers the conversion of a coal fired power station into a 100% biomass fired power station. A set of preliminary design documents have been reviewed and suggestions have been made for design improvement. Topics addressed include biomass logistics on-site, biomass pre-treatment, combustion and boiler aspects and emission reduction.

Activities performed: Review of preliminary design documents.

Rijksdienst voor ondernemend Nederland, Netherlands, Biomass roadmap South Africa, Mar 2015 - Jan 2016

Position: Senior Consultant
Description: This project is part of a government to government program between the Netherlands and South Africa. The BAPEPSA (Biomass Action Plan for Electricity Production in South Africa) project intends to define the requirements to create an enabling environment and promote the uptake of forestry and agricultural biomass for electricity production in South Africa. Key bioenergy technology factors to consider are availability, applicability and socio-economic attractiveness.

Activities performed: DNV GL provided key information of existing and new technologies that may be relevant for the South African bioenergy landscape and discussed these with project partners. A more detailed study was performed for selected technologies (co-firing, circulating fluidized bed, grate, digestion).

Attero, Netherlands, Troubleshooting and improvement of flue gas cleaning and waste water treatment system at a large waste incineration plant., Oct 2014 - Mar 2015

Position: Project manager, Senior consultant
Description: Waste processing utility has been supported to improve the performance of its flue gas cleaning and waste water treatment system. Based on the available operational data, and the preparation of relevant mass balances, suggestions for plant and operational modifications have been supplied, eventually resulting in improved system performance.

Activities performed: Desk study, extensive analysis of operational data, suggestions for improved operation, reporting

Nuon, Netherlands, Desk study on biomass co-firing in a large coal fired power plant, Sep 2014 - Mar 2015

Position: Senior consultant
Description: Desk study on co-firing of 50% biomass at the Hemweg 8 coal fired power plant. Focus on boiler aspects, flue gas cleaning and waste water treatment

Activities performed: Desk study

Procede / IEA Task 32, Netherlands, Desk study on technology and market development of biomass torrefaction, Sep 2014 - Dec 2014

Position: Senior consultant
Description: Desk study on the development of torrefaction, focusing on technology

development, market development, progress by developing companies and future perspective of torrefaction

Activities performed: Literature study, contacting technology suppliers, reporting

Climax Molybdenum, Netherlands, Improving of the performance of an industrial gas cleaning system, May 2014 - Nov 2016

Position: Project manager, Senior consultant

Description: An industrial gas cleaning system has been investigated and suggestions have been supplied to increase plant performance and to lower the emission values of the plant.

Activities performed: Desk study, investigations on location, meetings with system supplier, reporting

Energia Pecem, Brazil, Optimization of a flue gas desulphurization unit at a large coal fired power plant, Dec 2013 - Feb 2014

Position: Project manager, Senior consultant

Description: Optimization of a spray-dry absorber type flue gas desulphurization unit at a large coal fired power station. Unit suffered from many operational problems including clogging in absorbent preparation and in spent absorbent systems, process control issues, process water quality, maintenance issues. Several suggestions for modifications were provided, categorized in high, medium and low priority.

Activities performed: Preparation based on documents provided, one week investigation on site in Brazil, preparation of draft and final report.

Nuon, Netherlands, Evaluation of ESP and gas cooler performance, Jul 2013 - Oct 2013

Position: Senior consultant

Description: Evaluation of the performance of a gas cooler and an electrostatic precipitator in order to identify root causes for corrosion on a downstream gas compressor.

Activities performed: Study of power plant data and chemical analysis results, identification of improvement options, recommendations and reporting

Confidential, Netherlands, Buyer due diligence "Vigor", May 2013 - May 2013

Position: Senior consultant

Description: Full technical due diligence on behalf of potential buyer of energy from waste assets in the Netherlands

Activities performed: Senior consultant compliance issues

Confidential, Netherlands, Vendor due diligence "Amsterdam", Mar 2013 - Jun 2013

Position: Principal in charge, senior consultant

Description: Execution of a vendor due diligence assessment on behalf of a Dutch energy from waste utility

Activities performed: Principal in charge, senior consultant for compliance related issues

Confidential, United States, Market assessment for black pellets in Europe, Mar 2013 - Apr 2013

Position: Principal in charge, senior consultant

Description: Desk study on the market potential for black biomass pellets in several European countries, based on production of these pellets in the United States.

Activities performed: Market survey

TSA, Netherlands, Prevention of ammoniumbisulphite deposition on SCR catalysts, Feb 2013 - Jun 2013

Position: Project manager

Description: A model has been developed that can be implemented at coal fired power stations to provide an early -warning system for ammoniumbisulphite deposition on SCR catalysts

Activities performed: Literature desk study, model development, reporting

Southern Company, United States, Engineering feasibility study to retrofit Georgia Power Company's Plant Mitchell Unit 3 to 100% biomass direct injection, May 2012 - Nov 2012

Position: Principal in charge

Description: Feasibility study on the technical options and the cost for converting an existing coal fired unit to 100% biomass firing

Activities performed: Desk top study, plant visit, contact equipment suppliers

ESKOM, South Africa, Consultancy services for the works to explore the feasibility of (torrefied) biomass co-firing at Eskom, Apr 2012 - Apr 2013

Position: Principal in charge

Description: Study on the technical and economic feasibility of replacing coal by biomass for power generation in South Africa

Activities performed: Desk top study, market survey

UBE Industries Ltd., Japan, Evaluation of torrefaction process technology, Apr 2012 - Jul 2012

Position: Principal in charge

Description: Study on the status of torrefaction and steam explosion technology development

Activities performed: Desk top study, contact with technology suppliers

Nuon Energy, Netherlands, Exploratory study to assess the technological limitations and possibilities for 100% biomass operation at Hemweg 8, Sep 2011 - Jul 2012

Position: Principal in charge + task manager

Description: Desk study on the feasibility to convert the Hemweg 8 power plant into a 100% biomass fired unit.

Activities performed: Desk study, plant visit

Nuon, Netherlands, Protection of FGD at elevated inlet temperatures, Sep 2011 - Dec 2011

Position: Project Manager

Description: Desk study on several options to protect the FGD inlet when operated at elevated flue gas temperatures

Activities performed: Desk study based on in house experience and information from suppliers

ERB, Brazil, Torrefaction benchmark study, Jun 2011 - Nov 2011

Position: Project manager

Description: KEMA supports the client to evaluate technical options to convert biomass feedstock into torrefied material in Brazil.

Activities performed: Desk study based on in house knowledge and site visits.

Attero, Netherlands, Reduction of SO2 emissions at a WTE plant, Sep 2010 - Mar 2011

Position: Consultant/Project Manager

Description: Feasibility study and implementation of measures to reduce the emission of SO2 at a large waste incineration plant in the Netherlands

Activities performed: Desk study, analysis of plant data, evaluation of technology options, recommendations and reporting

Confidential, Netherlands, Coal to biomass repowering study, Jun 2010 - Feb 2011

Position: Consultant/Project Manager

Description: Techno-economic and portfolio assessment on the conversion of a large coal fired power station into a biomass plant (EU)

Activities performed: Desk study, analysis of plant data, techno-economic feasibility study, market and portfolio analysis, reporting

EPZ, Netherlands, Optimization of a FGD plant, Feb 2010 - Apr 2010

Position: Consultant/Project Manager

Description: Process optimization of a full-scale flue gas desulphurization plant in the

Netherlands

Activities performed: Analysis of process data, suggestions for test programs, evaluation of results, recommendations for improvement, reporting

Constellation Energy, United States, Co-firing feasibility study, Jun 2009 - Mar 2010

Position: Consultant/Project Manager

Description: Feasibility study on biomass co-firing and CO2 emission reduction at four coal-fired units

Activities performed: Coordination, data analysis, recommendations

EPZ, Netherlands, Study on further emission reduction at a large coal fired unit, May 2009 - Jan 2010

Position: Consultant/Project Manager

Description: Evaluation of technical options to further reduce the emissions of HF, SO2 and particulates at a Dutch power station

Activities performed: Complex study on emission reduction, reporting to competent authorities

Confidential, Portugal, HSE assessment on FGD plant, Mar 2009 - Apr 2009

Position: Consultant/Project Manager

Description: Assessment on health and safety aspects of a flue gas desulphurization unit at a large coal fired power station

Activities performed: Site assessment, recommendations for plant management, reporting

Eneco, Belgium, Assessment of a biomass digestion plant, Feb 2009 - Aug 2009

Position: Consultant/Project Manager

Description: Techno-economic assessment of a first-of-a-kind biomass digestion plant (EU)

Activities performed: Coordination of activities, process data analysis, site visits, recommendations for management and reporting

TSA, Netherlands, Study on the oxyfuel process, Mar 2008 - Nov 2008

Position: Consultant/Project Manager

Description: Study on the development status of the oxyfuel process for large coal-fired units, focusing on CO2 emission reduction

Activities performed: Coordination of desk study

RWE, Netherlands, Emission reduction of fluorine and mercury at a large coal fired unit, Jan 2008 - May 2008

Position: Consultant/Project Manager

Description: Feasibility study on additional emission reduction of mercury and fluoride at a large coal-fired power station in the Netherlands

Activities performed: Desk study, advice on reduction options for mercury emissions, reporting for competent authorities

ARN, Netherlands, Emission reduction of a WTE plant, Aug 2007 - Jan 2010

Position: Consultant/Project Manager

Description: Implementation of process modifications to improve the environmental performance of a large waste incineration plant

Activities performed: Support on implementation of adipic acid addition according to KEMA recommendations, ultimately leading to meeting all emission limits

Confidential, Italy, Co-firing feasibility study, Aug 2007 - Feb 2008

Position: Consultant/Project Manager

Description: Technical economic feasibility study of biomass co-firing at two coal and one oil-fired units of a European utility

Activities performed: Desk study, analysis of plant data, feasibility study, reporting

ARN, Netherlands, Testing of adipic acid in the WTE plant, Feb 2007 - Jun 2007

Position: Consultant/Project Manager

Description: Testing of the use of additives to increase the removal efficiency of pollutants in the flue gas cleaning system at the waste incineration plant of ARN in Nijmegen

Activities performed: Process data analysis, preparation of testing program, analysis of test results, recommendations for optimization, reporting

EDP, Portugal, Co-firing feasibility study for a large utility, Jan 2007 - Jul 2007

Position: Consultant/Project Manager

Description: Technical economic feasibility study of biomass co-firing at two coal-fired units of a European utility

Activities performed: Desk study, analysis of plant data, feasibility study, reporting

IPL, United States, Co-firing feasibility study for a large utility, Dec 2006 - Feb 2008

Position: Consultant/Project Manager

Description: Conceptual design of a co-firing facility at a power station of a US utility

Activities performed: Desk study, multiple site visits, data assessment, feasibility study, reporting

Confidential, Netherlands, Study on emission reduction at large fossil fuel fired units in the Netherlands, Jul 2006 - Apr 2007

Position: Consultant/Project Manager

Description: Study on the reduction potential and the costs of additional emission reduction of NOx and SO2 in all utility-owned coal and gas-fired power stations in the Netherlands between 2010 and 2020

Activities performed: Desk study, data crunching, compile, optimization of emission reduction measures at power facilities, reporting

AVR, Netherlands, Study on lifetime extension of WTE plant, Nov 2005 - Mar 2006

Position: Consultant/Project Manager

Description: Study on the lifetime extension of a waste incineration plant in the Netherlands

Activities performed: Analysis of plant data, multiple site visits, recommendations and reporting

ARN, Netherlands, Improving the performance of the flue gas cleaning system at a WTE plant, Sep 2005 - May 2006

Position: Consultant/Project Manager

Description: Troubleshooting at the flue gas cleaning system of the waste incineration plant of ARN in Nijmegen, in order to increase the removal efficiency of pollutants. Support during the implementation of the most effective options

Activities performed: Desk study, site inspection, process data analysis, advice and reporting resulting in meeting emission standards

Total Refinery Netherlands, Netherlands, Implementation of an emission monitoring system at an industrial plant, Aug 2005 - Nov 2005

Position: Consultant/Project Manager

Description: Design and validation (according to NEN-EN 14181) of an advanced PEMS monitoring system for a large furnace at Total Refinery Netherlands in Terneuzen

Activities performed: Development of complex PEMS

AVEBE, Netherlands, Implementation of an emission monitoring system at an industrial plant, Mar 2005 - Oct 2005

Position: Consultant/Project Manager

Description: Design and validation (according to NEN-EN 14181) of five PEMS monitoring systems for CHP units of AVEBE in Ter Apelkanaal, Foxhol and Gasselternijveen

Activities performed: Full set up of PEMS system

AVR, Netherlands, Alternative processing of spent active carbon at a WTE plant, Feb 2005 - Jun 2005

Position: Consultant/Project Manager
Description: Study on alternative processing of spent active carbon at the municipal waste incineration plants of AVR in the Netherlands
Activities performed: Desk study, analysis of process data, advice and reporting

Yara, Netherlands, Implementation of an emission monitoring system at an industrial plant, Jan 2005 - Dec 2005

Position: Consultant/Project Manager
Description: Design and validation (according to NEN-EN 14181) of an advanced PEMS monitoring system for a large boiler at Yara Sluiskil
Activities performed: Development of PEMS

Yara, Netherlands, Implementation of an emission monitoring system at an industrial plant, Jan 2005 - Dec 2005

Position: Consultant/Project Manager
Description: Design and validation (according to NEN-EN 14181) of four advanced PEMS monitoring systems for three ammonia reformers and a cogeneration plant at Yara, Sluiskil
Activities performed: Development of complex PEMS

Yara, Netherlands, Implementation of an emission monitoring system at an industrial plant, Jan 2005 - Dec 2005

Position: Consultant/Project Manager
Description: Preparation of a NOx emission monitoring protocol for the Yara fertilizer plant in Sluiskil
Activities performed: Development of complex NOx protocol

Yara, Netherlands, Implementation of an emission monitoring system at an industrial plant, Jan 2005 - Dec 2005

Position: Consultant/Project Manager
Description: Preparation of a CO2-index protocol for a cogeneration plant of Yara in Sluiskil
Activities performed: Development of CO2 protocol

Cerestar, Netherlands, Implementation of an emission monitoring system at an industrial plant, Jan 2005 - May 2005

Position: Consultant/Project Manager
Description: Preparation of four CO2-index protocols and four NOx and CO2 emission protocols for several plants of Cerestar/Cargill
Activities performed: Full set up of complex PEMS system

Nea, Netherlands, Evaluation of emission monitoring protocols, Aug 2004 - Feb 2005

Position: Consultant/Project Manager
Description: Evaluation of several NOx & CO2-index protocols by order of the Dutch Emission Authorities (Nea)
Activities performed: Desk study, evaluation and further development of monitoring protocols, reporting

Eskom, South Africa, Testing of FGD absorbents, May 2004 - Jul 2004

Position: Consultant/Project Manager
Description: Evaluation of the quality of lime-based sorbents for application in flue gas desulphurization plants by order of Eskom (South Africa)
Activities performed: Preparation of test program, analysis of results, reporting

Stadtwerke Chemnitz, Germany, Reduction of particle emissions from a tall stack, Mar 2004 - Aug 2004

Position: Consultant/Project Manager

Description: Consultancy related to the reduction of particle emissions from the stack at Stadtwerke Chemnitz power station (Germany)

Activities performed: Plant inspection, desk study, reporting

British Energy, United Kingdom, Reduction of droplet emission from a tall stack, Feb 2004 - Nov 2004

Position: Consultant/Project Manager

Description: Consultancy related to the reduction of condensate droplet emission from the stack at British Energy's Eggborough power station (UK)

Activities performed: Analysis of process data, coordination of set-up and execution of CFD model calculations, reporting

American Electric Power (AEP), United States, Realization of an extensive emission reduction database, Sep 2003 - May 2004

Position: Consultant/Project Manager

Description: Realization of a database containing advanced flue gas cleaning technologies with a horizon of 10 years for the coal-fired power stations (30,000 MWe) of American Electric Power (AEP)

Activities performed: Desk study on technologies, preparation of Access database, reporting

Ministry of Environmental Affairs (VROM), Netherlands, Reduction of SO₂ emissions from Dutch power stations, Oct 2002 - May 2003

Position: Consultant/Project Manager

Description: Study on the SO₂ emissions of the Dutch electricity production companies and on the possibilities for further emission reduction

Activities performed: Desk study

Essent Energie Productie, Netherlands, Emission reduction of SO₂ and particulates at a large coal fired unit, Jan 2002 - May 2002

Position: Consultant/Project Manager

Description: Study on the reduction of the emissions of SO₂ and particulates at EPZ Borssele 12 power station

Activities performed: Desk study based on process data and literature

E.ON Benelux Generation, Netherlands, Improvement of gypsum quality at a large coal fired utility, Nov 2001 - Feb 2002

Position: Consultant/Project Manager

Description: Improvement of the gypsum quality at Maasvlakte coal-fired power station

Activities performed: Desk study, site inspection, analysis of process data, suggestions for plant improvement, reporting

E.ON Benelux Generation and Reliant Energy Power Generation, Netherlands, Emission reduction when co-firing >10% biomass, Sep 2001 - Nov 2001

Position: Consultant/Project Manager

Description: Desk study flue gas treatment during co-combustion of > 10% of biomass in coal installations

Activities performed: Desk study

AVR and Auto Recycling Nederland, Netherlands, Study on processing of ASR, Mar 2001 - Mar 2002

Position: Consultant

Description: On behalf of AVR and Auto Recycling Nederland research into the feasibility of processing (car) shredder residue by AVR Waste Incineration Installation. This included the following activities: evaluation of possibilities of a shredder residue market, development of operational concepts of shredder residue, co-ordination of incineration tests for shredder residue

Activities performed: Literature study, technology assessment, preparation of test program, analysis of test results, reporting.

OMYA Polska, Poland, Testing of FGD absorbents, Apr 2000 - Jul 2000

Position: Consultant/Project Manager
Description: tests on the reactivity of absorbents for flue gas desulphurization installations
Activities performed: Preparation of test program, analysis of results, reporting.

NEDMAG, Netherlands, Emission reduction at an industrial plant, Mar 2000 - Jul 2000

Position: Consultant/Project Manager
Description: Optimization of a flue gas treatment system
Activities performed: Analysis of process data, proposals for improvement, reporting

Danieli-Corus, Netherlands, Biological flue gas cleaning, Feb 2000 - Nov 2002

Position: Project Manager
Description: On behalf of Danieli-Corus an extensive experimental research program was carried out to investigate the possibilities of applying biological flue gas denitrification in combination with wet limestone-gypsum flue gas desulphurization. This included the following activities: responsible for the daily management of the pilot plant research during 10 months, giving advice to Danieli-Corus on items of conflict between the two processes and with regard to the practical application
Activities performed: desk study, modification of pilot plant, coordination of trials, analysis of results, reporting

LHOIST, Belgium, Testing of FGD absorbents, Nov 1999 - Feb 2000

Position: Consultant/Project Manager
Description: Pilot plant experiments on the reactivity of absorbents for flue gas desulphurization
Activities performed: Preparation of test program, analysis of results, reporting.

Elektrownia Dolna Odra, Poland, Owners representative during construction of FGD plant, Feb 1998 - Aug 2001

Position: Consultant
Description: Elektrownia Dolna Odra Power Station, Poland; during the engineering, construction and start-up of the flue gas desulphurization plant, including common installations at the units 1&2. This included the following activities: review of the basic engineering of the plant, review of operation manual, support activities during commissioning and pre-operational testing, review of the set-up and the results of the guarantee tests of the plant
Activities performed: Owners representative

Elektrownia Opole, Poland, Optimization of a FGD plant, Jul 1997 - Jul 1999

Position: Consultant
Description: Elektrownia Opole, Poland: the optimization of the flue gas desulphurization plants at the Opole Power Station. This included the following activities: streamlining the procedures for collecting process and laboratory data, preparation of a spreadsheet for the operational costs of the plants, generation of proposals for a reduction of the operational costs of the plants, advice on operational improvements
Activities performed: preparation of management support system on performance of flue gas desulphurization (FGD) plant, optimization of FGD plant

Elektrownia Jaworzno III, Poland, Maintenance support for an FGD plant, Apr 1997 - Jul 1999

Position: Consultant
Description: Elektrownia Jaworzno III, Poland; during the annual maintenance stops of the flue gas desulphurization plant at the Jaworzno III Power Station:
- inspection of linings in flue gas ducts, vessels and absorbers
- inspection of major components of the flue gas desulphurization plant

Activities performed: Maintenance inspections on site, reporting, advising.

Elektrownia Opole, Poland, Owners representative during construction of FGD plant, Mar 1995 - Oct 1997

Position: Consultant

Description: Elektrownia Opole, Poland; during the engineering, construction and start-up of the flue gas desulphurization plants at the Opole Power Station. This included: review of the basic engineering of the plant, review of the results of the guarantee tests of the plant, advice on operational improvements

Activities performed: Owners representative

TSA/COP, Netherlands, Program Manager Emission Reduction, Jan 1994 - Dec 2000

Position: Project Manager

Description: In the field of flue gas treatment within the project 'emission reduction', part of the 'Collectieve Opdracht Productie' of the joint Dutch Electricity Generating Companies: laboratory and pilot plant experiments on the reactivity of absorbents for flue gas desulphurization installations, pilot plant experiments and a full-scale demonstration with regard to the oxidation of sulphate in flue gas desulphurization installations, pilot plant experiments and a full-scale demonstration on the use of additives in flue gas desulphurization systems, modeling of wet lime(stone) gypsum FGD process, laboratory and pilot plant experiments to determine the reactivity of DeNOx catalyzers, laboratory and pilot plant experiments to determine the de activation of DeNOx catalyzers as a result of firing secondary fuels in coal plants, modeling catalytic DeNOx, pilot plant and full-scale demonstration of the application of additives to improve the SO2 capture in flue gas desulphurization installations, evaluation of the effects of using rotating classifiers in coal-fired power plants on the emission of NOx and the carbon content in fly ash, pilot plant experiments and full-scale demonstration on the reduction of NOx emissions by means of advanced re-burning in coal-fired units, studies on the removal, storage and processing of CO2 from the flue gases of power plants

Activities performed: Project management including control of progress and financials of R&D projects on flue gas cleaning

Several laboratories, Various countries, pilot experiments in the field of flue gas desulphurization, Jan 1992 - Jun 1994

Position: Specialist/Project Manager

Description: In several laboratory and pilot experiments in the field of flue gas desulphurization

Activities performed: set up and execution of pilot plant tests

CURRICULUM VITAE

Frans van Aart

Principal Consultant

Personal statistics

Citizenship: Dutch

Date of birth: May 30, 1955

Language capabilities

Language	Speaking	Reading	Writing
English	Good	Good	Good
German	Good	Good	Good
French	Basic	Basic	Basic
Dutch	Excellent	Excellent	Excellent

Academic and professional attainment

Field of expertise	University/School	Year
MSc Mechanical Engineering	Technical University Eindhoven	Aug 1974 - Jun 1980
GCSE A'levels	Secondary Modern School	Sep 1970 - Jun 1974

Summary of professional experience

Mr. Frans Van Aart is a project manager/principal consultant with more than 30 years of in-depth and broad-ranging experience in the area of power generation. His professional experience has been gained by operating from process engineer to project manager in relation to feasibility studies as well as the realization of new built power plants, including conventional (coal, gas, waste, biomass fired) power plants as well as innovative pilot plants (oxyfuel, liquefaction, pre-combustion carbon capture). Frans is a member of the Eurelectric working group on BREF LCP.

Clients appreciate Frans van Aart's technical knowledge as well as his social and managerial skills.

He has expertise in a broad range among which: Thermodynamics, Project Management, Business Development, Employer's Representative, Independent/Bank Engineer, Techno-economic feasibility studies, Power plant commissioning and Environmental Regulation

Frans van Aart is specialized in:

- power stations, including coal, gas, municipal waste and biomass-fired plants
- coal gasification, liquefaction, pre-combustion capture
- boilers, gasifiers and synthesis gas coolers
- coal and ash handling systems
- emissions and emission prevention and control measures.

Publications and papers

Professional training

Year	Institute	Description
Jun 2011 - Jun 2011	HC	Training Course IPMA C
2011 - 2011	PBNA	Health & Safety for Management (VCA voor leidinggevend)
2001 - 2001	PBNA	Health & Safety for Management (VCA voor leidinggevend)
2000 - 2000	Insight Organisation	The Principles of Bid Management

1999 - 1999	NIMO	Senior Project Management
1998 - 1998	PBNA	Health & Safety (VCA)

Other information

n.a.

Employment record

DNV GL **Sep 1982 - Jun 2017**

Position: Principal Consultant

- jan 2015 - date: Principal Consultant Green Thermal Power
- feb 2012 - jan 2015: Service Line Principal Process Technology and Measurement
- sept 1982 - jan 2012: Project Manager/Consultant

Dutch army **Jan 1981 - Jul 1982**

Position: Officer civil courses

Detailed professional experience

Eneco Warmteproductie Utrecht B.V., Netherlands, NOx reduction of Heat Only Boiler, Nov 2016 - Jan 2017

Position: Senior Consultant

Description: Support in tendering procedure for refurbishment of four boilers to make them compliant with new NOx emission requirements

Activities performed: Drafting of technical sections in tender documentation and evaluation of bids

European utility, [confidential], Vendor due diligence of renewable assets, Oct 2016 - Dec 2016

Position: Senior Consultant

Description: Technical vendor due diligence of hydro power plants

Activities performed: Historic review and forecasting (P50, P90) of the performance of hydro power plants

Confidential, Netherlands, Security of supply of utilities, Nov 2015 - Mar 2016

Position: Project Manager

Description: Assessment of the reliability of the supply of utilities to an industrial estate

Activities performed: DNV GL made an inventory of the demand side requirements to determine the required amount, quality and continuity of utilities. In a risk analysis, the likelihood and impact of an interruption of the utility supply are determined. The risk register gives the client an overview of the most critical systems, which need further attention

Coördinatie Centrum Energie VU/VUmc (CCE), Netherlands, Condition Assessment of Assets, Nov 2015 - Feb 2016

Position: Team leader

Description: Preparation of an overview of the assets and the condition

Activities performed: CCE is responsible for the supply of electricity, hot and cooled water and compressed air to the hospital and university of VU/VUmc. CCE is considering to continue as a private limited company. As such CCE is interested in a complete and correct overview of the assets and the condition of the assets

Confidential, [confidential], Feasibility Study of a new combined cycle power plant, May 2015 - Nov 2015

Position: Team leader
Description: Consultancy services for techno-economic feasibility study, environmental review, gas pricing
Activities performed: Preparation of Basis of Design, Conceptual Design packages of viable concepts, techno-economic assessment of most feasible concept

Slovenské Elektrárne, Slovakia, Technical Condition Assessment Gabčíkovo hydro power plants, Feb 2015 - Apr 2015

Position: Senior Mechanical Consultant
Description: An assessment to the technical condition of the hydro power plants (HHP) of the Gabčíkovo water works: HPP Gabčíkovo (720.0 MW), HPP Cunovo (24.0 MW), SHPP Mošon (1.26 MW) and SHPP S VII (1.04 MW)
Activities performed: An independent opinion whether the hydro power plants have been operated and maintained properly by Slovenské Elektrárne (SE). The assignment includes a limited condition assessment of the mechanical equipment, based on a visual inspection of the equipment, interviews with staff members and review of relevant documentation

Maersk, United States, Tri-Gen Boiler Assessment, Aug 2014 - Sep 2014

Position: Thermodynamic / boiler expert
Description: Technology Qualification
Activities performed: Reviewing development of a pressurized oxygen burner /boiler

VU, Netherlands, Realisation of a combined heat and power plant, Aug 2013 - Sep 2015

Position: Independent Reviewer
Description: Review of basic and detailed design, Audit of QA programme, Commissioning Manager
Activities performed: Design review and coordination commissioning of CHP

DNV GL, Netherlands, Principal Consultant, Mar 2012 - Jan 2015

Position: Service Line Principal
Description: Business Development for Process Technology and Measurements
Activities performed: Opportunity Manager

Vattenfall / Nuon, Netherlands, Scale Up Biomass Co-gasification Hardware Modifications, May 2011 - Dec 2012

Position: Engineering Manager
Description: Basic Engineering (incl. cost estimate) and Tendering of Hardware Modifications required for increase of biomass co-gasification rate
Activities performed: Leading conceptual design; preparation of Tender Documents; Contracting Strategy

Nuon, Netherlands, Hammer Mill Buggenum, Jan 2011 - Nov 2011

Position: Project manager
Description: Tendering of biomass milling facility at the IGCC in Buggenum
Activities performed: Leading the preparation of tender documents and the evaluation of the received Bids

Nuon, Netherlands, CO2 Catch-up, Feb 2010 - Apr 2011

Position: Project manager
Description: Realisation of a CO2 pre-combustion capture pilot plant at the IGCC in Buggenum
Activities performed: Managing the project team during construction and commissioning of CO2 Capture plant

EMAL, United Arab Emirates, Impact assessment of Carbon Capture at EMAL, Aug 2009 - Dec

2009

Position: Project Manager

Description: Technical and financial assessment of the supply of utilities (including power, steam, process water) from a gas fired combined cycle to a carbon capture plant

Activities performed: Leading a team assessing the technical and financial consequences of utility supply

Dutch Utilities, Belgium, Update BREF LCP, 2008 - Jun 2017

Position: Senior Consultant

Description: Member of the Eurelectric working group for the review of the BREF LCP (reference document for best available techniques for the combustion of gaseous fuels and co-combustion of secondary fuels in Large Combustion Plants)

Activities performed: Review of the BREF LCP; assist European IPPC Bureau as Technical Working Group member

Nuon B.V., Netherlands, CO2 Catch-up, 2007 - Feb 2010

Position: Site Development Manager

Description: Realisation of a CO2 pre-combustion capture pilot plant at the IGCC in Buggenum

Activities performed: Managing the IGCC's interest in the realization of capture plant

Enemalta, Malta, Delimara Boiler Conversion; feasibility, basic design and tendering, 2007 - Jun 2009

Position: Project Manager

Description: Reduction of the emissions of an oil-fired power plant (feasibility study and tendering process)

Activities performed: Feasibility study and tendering for an oil-fired power plant

Nuon, Netherlands, TAR Magnum multi-fuel plant, 2007 - 2007

Position: Technical Assurance Reviewer

Description: Multi fuel (coal, natural gas, biomass) based IGCC with CO2 capture

Activities performed: Technical assurance of an IGCC with CO2 capture

SEQ, Eneco, Netherlands, Conceptual Design ZEPP, 2007 - 2007

Position: Project Manager

Description: Conceptual design of a zero-emission power plant (oxyfuel) and the drafting of functional specifications

Activities performed: Supported the clients with conceptual design and functional specifications

Nuon B.V., Netherlands, CTL-POP, 2006 - Jun 2011

Position: Technical Asset Manager

Description: Realisation of a coal-to-liquids pilot plant at the IGCC in Buggenum

Activities performed: Support the client with the realization of a coal-to-liquids plant

Eneco, Netherlands, Tolling costs power generation, 2006 - 2007

Position: Senior Consultant

Description: Determination of tolling costs of coal based power plants (coal combustion as well as gasification)

Activities performed: Determined the tolling costs of coal based power plants

American Electric Power, United States, Assessment of co-firing biomass, 2006 - 2007

Position: Senior Consultant

Description: Conceptual design and techno-economic assessment of co-firing biomass in AEP's coal fired power stations

Activities performed: Supporting of client with an assessment for co-firing of biomass

Ofgem, United Kingdom, ROCs verification, 2006 - 2006

Position: Auditor

Description: Verification of the Renewables Levy Exemption Certificates and Renewables Obligation Certificates issued to co-firing generating stations

Activities performed: Auditor for certificates for co-firing

Valorsul S.A., Portugal, Improvement Waste-to-Energy plant, 2005 - 2008

Position: Project Team Manager

Description: Upgrade and energy efficiency assessment of the Waste-to-Energy Plant Lisbon, Portugal, including proposal of recommended improvements, tendering and supervision of the implementation

Activities performed: Acted as project manager during an upgrade and energy efficiency assessment of a WTE plant

EdF Energy, United Kingdom, Co-firing biomass at West Burton Power, 2005 - 2005

Position: Senior Consultant

Description: Review of the basic design and tendering documents for a biomass storage and handling facility for co-firing at West Burton Power plant, England

Activities performed: Reviewed basic design and tendering documents

Scottish Power, United Kingdom, Co-firing of biomass at Longannet Power Station, 2005 - 2005

Position: Senior Consultant

Description: Assessment of possible routes for direct co-firing of biomass at Longannet Power Station, Scotland

Activities performed: Assessment of routes for biomass supply

AVR, Netherlands, Technical Assessment of Waste-to-Energy Plant, 2005 - 2005

Position: Team Manager/Senior Consultant

Description: Assessment of the technical condition of the Waste-to-Energy Plant Brielselaan and required investments with respect to lifetime extension until 2030

Activities performed: Assessed technical condition and required investments for WTE plant

Several utilities, Netherlands, IPPC scans, 2004 - 2007

Position: Senior Consultant

Description: Assessment of the compliance to the IPPC directive (Integrated Pollution Prevention and Control) in power plants and waste-to-energy plants

Activities performed: Assessed the compliance to the IPPC directive of various plants

AVR, Netherlands, Concept selection biomass fired power plant, 2004 - 2005

Position: Senior Consultant

Description: Study to the feasibility of a combined cycle and a biomass fired power plant at Rozenburg

Activities performed: Performed feasibility study

SPE, Belgium, Energy Efficiency Assessment, 2004 - 2005

Position: Senior Consultant

Description: Assessment of the energy efficiency of SPE's Flemish fossil fired power plants and the drafting of Energy Plans

Activities performed: Performed an Energy Efficiency Assessment

EPZ, Netherlands, Refurbishment steam turbine, 2004 - 2004

Position: Senior Consultant

Description: Preparation of a functional specification and evaluation of tenders for upgrading the steam turbine of the nuclear power plant at Borssele

Activities performed: Supported the client with preparation of functional specs and tender evaluation

E.ON Benelux B.V., Netherlands, Remote controlled power plants, 2003 - 2004

Position: Facilitator Knowledge Management
Description: Surveying and securing the knowledge of operators and trouble shooters of the gas fired power plants
Activities performed: Knowledge assurance

On behalf of NIB Capital by order of Siemens Nederland B.V., Netherlands, Poultry litter fired power plant, 2003 - 2004

Position: Project Manager
Description: Due diligence of the quality of the available fuel and the marketability of the produced ashes of the poultry litter fired power plant of DEPR, Moerdijk
Activities performed: Project Manager for a due diligence

SCA Packaging De Hoop, Netherlands, Energy efficiency improvement, 2003 - 2003

Position: Senior Consultant
Description: Feasibility of usage of heat from the flue gases downstream the WHB for drying processes
Activities performed: Did a feasibility study for efficiency improvement

AVR/AVIRA, Netherlands, Steam turbine damage, 2003 - 2003

Position: Team Leader
Description: Investigation of the cause of damage of steam turbine blades
Activities performed: Led the team that performed a root cause investigation

Norit Nederland B.V., Netherlands, HAZOP, 2002 - 2002

Position: Senior Consultant
Description: Hazard and Operability Study (HAZOP) of a coconut cokes pulverizer plant
Activities performed: Did a HAZOP for biomass pulverizer plant

Vijfhoek N.V. and Municipality of Almere, Netherlands, Concept selection Waste-to Energy plant, 2002 - 2002

Position: Senior Consultant
Description: Technical and economic feasibility of an innovative (incineration, pyrolysis, gasification) Waste-to-Energy Plant
Activities performed: Performed feasibility study

Nuon ET&W, Netherlands, Technical due diligence, 2001 - 2001

Position: Team Leader
Description: Technical due diligence of a 60 MWe/63 t/h steam Combined Cycle for reconstruction to improve the start-up and power demand response capability
Activities performed: Team Leader for a technical due diligence

Torbed Consortium, Netherlands, Market Survey Torbed, 2001 - 2001

Position: Senior Consultant
Description: Preparation of a Market Survey of gasification systems based on the Torbed technology
Activities performed: Participated in a market survey for gasification systems

Essent Energy, Netherlands, Co-firing in coal fired power plants, 2001 - 2001

Position: Senior Consultant
Description: Assessment of the influence of co-combustion on the availability and reliability of coal-fired power plants
Activities performed: Did an assessment on availability and reliability for co-firing

Shell Global Solutions, Nigeria, Afam power station, 2001 - 2001

Position: Team Leader
Description: Functional technical specifications for the Rehabilitation or Replacement of the

Power Generating Facilities of an existing Power Station in Nigeria, including the Review of a Power Purchase Agreement (PPA) relating to the extension of this Power Station

Activities performed: Drafted technical specifications and reviewed the PPA

EnergieNed, Netherlands, BREF LCP, 2000 - 2004

Position: Senior Consultant

Description: Preparation in a Eurelectric/VGB working group of a reference document for best available techniques for the combustion of gaseous fuels and co-combustion of secondary fuels in Large Combustion Plants (BREF-LCP)

Activities performed: Preparation of reference document for BAT for combustion and co-combustion of secondary fuels in LCP's

Fibroned BV, Netherlands, Employer's Representative Services biomass fired power plant, 2000 - 2004

Position: Project Coordinator

Description: Pre-qualification, tendering, evaluation and contract negotiations of a 30 MWe poultry litter-fired combined heat and power station in Apeldoorn (the Netherlands)

Activities performed: Representation of Employer during pre-qualification, tendering, evaluation and contract negotiations

Dutch Utilities, Netherlands, Various projects, 2000 - 2000

Position: Senior Consultant/Project Manager

Description: - Assessment and optimization of the combustion of a coal-fired power station - Investigation of possible improvements of the coal milling performance of a coal-fired power station - Development of computer model for the prediction of the performance of coal mills

Activities performed: Various activities for coal fired power plants regarding combustion and milling.

Thomassen Power Systems BV, Netherlands, Esenyurt power plant, 1999 - 2001

Position: Project Manager

Description: Process design check, inspections and performance measurements of a combined cycle co-generation heat and power plant in Turkey

Activities performed: Support during design and commissioning

Rabobank, Netherlands, Delesto 2, 1999 - 2001

Position: Banker's Engineer

Description: Commissioning, performance testing and punch listing of a 350 MWe combined cycle of Delesto at Delfzijl, the Netherlands

Activities performed: Support during commissioning

Dutch Utilities, Netherlands, Co-firing secondary fuels in Dutch power plants, 1999 - 2001

Position: Project Manager

Description: Investigation of technical limits of co-firing alternative fuels in Dutch pulverized coal-fired power plants

Activities performed: Assessment of technical limits co-firing

Rousch Pakistan Power Ltd, Pakistan, Commissioning test Rousch power plant, 1999 - 1999

Position: Team Leader

Description: Witnessing as independent engineer of commissioning and testing of an HFO-fired combined cycle in Abdul Hakim (Pakistan)

Activities performed: Acting as independent engineer for an HFO CAPP

Confidential, Various countries, Rotating Particle Separator, 1998 - 2001

Position: Project Manager

Description: On behalf of KEMA, Rothemühle and Kappa for the demonstration of a new gas

turbine inlet filter at Kappa Graphic Boards.
Activities performed: Demonstration of new Gas Turbine inlet filter

Senter Novem, Netherlands, Various projects, 1998 - 1998

Position: Project Manager
Description: - Investigating the possibilities of the use of biomass in industrial installations and, in particular, in asphalt mixing plants - Several feasibility projects in the field of combined cycle technology (process, electrical and environmental aspects with respect to location choice, site survey, evaluation of different combined cycle concepts with respect to process, availability and economic/financial aspects) - Feasibility studies in the area of co-gasification of biomass and secondary fuels
Activities performed: Various projects in industrial installations

AVIRA, Netherlands, Avira 2, 1997 - 1997

Position: Project Coordinator
Description: Commissioning of a waste incineration power plant
Activities performed: Coordination of commissioning activities waste incineration plant

Dutch Utilities, Netherlands, Coal Gasification, 1995 - 1996

Position: Project Manager
Description: Several optimizations (efficiency increase with lower investments) projects in the area of coal gasification (coal pressurization, gasifier, syngas cooler)
Activities performed: Performed various efficiency increase projects in the area of coal gasification

ARN, Netherlands, Performance test line 2, 1995 - 1996

Position: Project Manager
Description: Acceptance inspections and performance tests of two municipal waste incinerators at Nijmegen, the Netherlands
Activities performed: Witnessed during building and commissioning

European Commission, Ukraine, Ulegorsk, 1995 - 1996

Position: Project Manager
Description: Topping cycle process design (feasibility study repowering Ulegorsk Power Plant (combined cycle), Ukraine)
Activities performed: Performed a feasibility study

Demkolec, Netherlands, Realisation IGCC, 1989 - 1994

Position: Project Engineer
Description: In the Demkolec project team for a 250 MWe IGCC Plant in Buggenum, for the basic and detailed engineering, fabrication, delivery, construction and commissioning of the gasifier and syngas cooler, complete with the water/steam systems
Activities performed: Responsible for a team that supported the client during preparation, building and commissioning of the project

Dutch Utilities, Netherlands, Demkolec R&D tests, 1989 - 1994

Position: Project Engineer
Description: On behalf of Research & Development projects (material testing, temperature measurement in gasifier, determination of heating value syngas) in the 250 MWe IGCC in Buggenum, the Netherlands
Activities performed: Project Engineering for research and development projects

Demkolec, United States, Design IGCC, 1989 - 1989

Position: Project Engineer
Description: Observer during test runs in the Shell Coal Gasification Pilot Plant in Deer Park, near Houston, Texas, USA in order to establish the design conditions for the Demkolec 250 MWe Integrated Coal Gasification Combined Cycle (IGCC) Plant in

Buggenum, the Netherlands

Activities performed: Observed the test runs in USA for the Buggenum IGCC

PZEM, Netherlands, Fly ash handling BS12, 1986 - 1989

Position: Project Manager

Description: Total boiler equipment, including the fly ash handling system during the construction and commissioning of the Borssele coal-fired power plant

Activities performed: Acted as project manager for the boiler equipment during construction and commissioning

PZEM, Netherlands, Flue Gas Desulphurization BS12, 1986 - 1989

Position: Project Engineer

Description: Borssele flue gas desulphurization unit

Activities performed: Engineering for FGD unit

Confidential, Netherlands, BS12, 1986 - 1989

Position: Coordinator

Description: Coordinator of all KEMA activities concerning the conversion of the Borssele Thermal Power Station (the Netherlands), including engineering, construction supervision and commissioning

Activities performed: Coordination of all activities of KEMA during this project

PZEM, Netherlands, Boiler BS12, 1982 - 1986

Position: Project Engineer

Description: - Project Engineer within a project team at the Borssele Power Station, for the conversion from oil/gas-firing to coal-firing; responsible for the engineering, fabrication and delivery of the total boiler equipment, including fly ash handling system - Thermodynamic cycle calculations in relation to the engineering of equipment and prediction of the unit efficiency

Activities performed: Project engineering

EBR, Netherlands, District heating EBR, 1982 - 1983

Position: Process Engineer

Description: Design and calculations for co-generation combined cycle power plants for electricity production and district heating

Activities performed: Process engineering for CHP power plants

CURRICULUM VITAE

Frans BLANK

Principal Consultant

Personal statistics

Citizenship: Dutch

Date of birth: Jul 07, 1961

Language capabilities

Language	Speaking	Reading	Writing
English	Good	Good	Good
German	Good	Good	Good
French	Fair	Fair	Basic
Dutch	Excellent	Excellent	Excellent

Academic and professional attainment

Field of expertise	University/School	Year
MSc Chemistry (main subject Analytical Chemistry/subsidiary subject Environmental Chemistry)	University of Amsterdam	Aug 1979 - Aug 1987
GCSE A'levels	Secondary Modern School	Aug 1973 - Jun 1979

Summary of professional experience

Mr. Frans Blank has intensive knowledge on all aspects of emission monitoring, ambient air monitoring and dispersion modelling. His in-depth experience with the statistical aspects benefits the quality assurance of environmental analysis. This is commonly applied for uncertainty analysis of greenhouse gas monitoring in emission trading systems and for writing monitoring procedures for emission to air, water and energy monitoring

His education in Analytical and Environmental Chemistry was deepened through implementation of analytical techniques and statistical methods. This made him familiar with setting up training programs, laboratory accreditation, validation of analytical methodologies and implementation of Laboratory Information Management Systems

Due to personal experience and qualifications Frans Blank easily co-operates with others and he has good organizational qualities. His analytical insight enables him to distinguish essential tasks of complex cases and to easily come to core business. He is, therefore, the right person for managing projects, aiming at solutions and accurately taking care of the financial aspects. Furthermore, he is an experienced trainer and instructor.

Publications and papers

8. F.T. Blank; J.J. de Wolff, CCS with EOR, assessing the suitability of existing monitoring regulations, <http://www.co2-cato.org/publications/library>, Dec 01, 2013
9. F.T. Blank; T. Slot, Power Generation in Liberalized Market; Lessons Learned From North West Europe, International Energy & Environment Fair and Conference (ICCI 2013), Apr 24, 2013
10. F.T. Blank; R. Catau, J.J. de Wolff, Technical and Legal aspects of CO2 transport by ship and implementation of the CO2 flow monitoring, <http://www.co2-cato.org/publications/library>, Jan 12, 2013
11. F.T. Blank et al, Validated methods for flue gas flow rate calculation with reference to EN 12952-15, VGB PowerTech, Feb 01, 2012

12. F.T. Blank, R. Catau, A. Haan-Kamminga, Permitting cross border networks in relation to monitoring, verification and accounting under EU-ETS, <http://www.co2-cato.org/publications/library>, Nov 28, 2011
13. F.T. Blank et al., Impact of the Industrial Emissions Directive on the European Power Industry, CEM 2011 - 10th International Conference on Emissions Monitoring, Oct 05, 2011
14. F.T. Blank et al, Issues concerning the implementation of the CCS Directive in the Netherlands, Energy Procedia 4 (2011) 5479–5486, Jan 01, 2011
15. F.T. Blank; H. Spoelstra, Assessment of accuracy required by the Monitoring and Reporting Guidelines for CCS under the EU-Emission Trading System, <http://www.co2-cato.org/publications/library>, Nov 25, 2010
16. F.T. Blank; H. Spoelstra, Practical guidance for monitoring plans for CCS, under the Monitoring and Reporting Guidelines for CCS of the EU Emission Trading System, <http://www.co2-cato.org/publications/library>, Sep 16, 2010
17. F.T. Blank et al, European Power Industry Experience of EN14181, VGB PowerTech 1/2, Jan 01, 2010
18. F.T. Blank, Quality control of the NOx annual load in the Dutch emission trading system, VGB Essen, Germany, Jan 01, 2003
19. F.T. Blank, Certification of a Laboratory for soil and croptesting, Proceedings of Quality of soil and plant analysis in view of Sustainable Agriculture and the Environment, Wageningen, The Netherlands. Commun. Soil Sci. Plant Anal. 27/3-4 (1996), p. 349-363, Jan 01, 1996
20. F.T. Blank, Possibilities of New Analytical Methods and Techniques on Environmental Care in a Laboratory for Soil and Croptesting, Proceedings of AOAC international Europe section 4th international symposium, Nyon, Switzerland, Jan 01, 1994
21. F.T. Blank, Automated NIR analysis for feed evaluation, Proceedings of the 5th International Conference on Near Infrared Spectroscopy, Haugesund, Norway, Jan 01, 1992
22. F.T. Blank et al., Presence of Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans in Fish-Eating Birds and Fish from the Netherlands, Arch. Environ. Contam. Toxicol. 16, 149-158, Jan 01, 1987
23. F.T. Blank et al., Dinuclear Silver(I) and Copper(I) Complexes with Neutral N2S2 Donor Ligands and their Reactivities Towards CO. Structures in Solution (1H and INEPT 109Ag NMR) and in the Solid (X-ray) of [Ag2{μ-⊖(S)-1,2-(thiophene-2-CN=N)2-cyclohexane}2]O3SCF3)2, Inorganica Chimica Acta, 98, 107-120, Jan 01, 1985

Professional training

Year	Institute	Description
Jan 2015 - Mar 2015	Internal DNV GL	Commercial Excellence
Nov 2014 - Dec 2014	Internal DNV GL	Project Management the Energy Way & Project Management Essentials
Sep 2012 - Sep 2012	Royal PBNA	Safety for Operational Managers (VCA)
Mar 2010 - Apr 2010	Canadian Standards Association - Education & Training	Train the Trainer Seminar: Green House Gas - Inventory using ISO 14064-1; - Project Validation using ISO 14064-2 and Verification using ISO 14064-3
Feb 2009 - Mar 2009	Huthwaite International	SPIN Selling Skills (Situation, Problem, Implication & Need-payoff)
May 2007 - Oct 2008	DNV GL (Corporate)	KEMA Professional Development
Mar 2007 - Apr 2007	DGMR	Geomilieu Basic Course Environmental Noise Modelling; Industrial Noise Modelling and Road Traffic Noise Modelling
Jan 2007 - Jan 2007	DEKRA	Train the trainer
Jan 2006 - Jan 2006	Bureau Zuidema	Advisory skills

Jun 2002 - Jun 2002	Schouten & Nelissen - KDI (IRCA: IQA International Register of Certified Auditors)	ISO 9000:2000 Auditor/Lead Auditor; 40 Hour Training Course and Examination
Aug 2000 - Oct 2000	ISBW Education and Training	Personal Management
Oct 1996 - Oct 1996	Centre for Professional Advancement	Effective Project Management
Oct 1994 - Oct 1994	Post Academic Education Health and Environmental Technique	New Developments in Analytical Chemistry for Environmental Analysis
Sep 1994 - May 1995	ISW; Institute for Social Sciences	Higher Management
Apr 1993 - Apr 1993	The Centre for Professional Advancement	Statistical Process Control
Jan 1989 - Jan 1995	In-house training and education	Near Infrared Spectroscopy, Statistics & Chemometrics, Laboratory Information Management Systems, ICP Atomic Emission Spectroscopy, Biological Analysis

Other information

n.a.

Employment record

DNV GL

Apr 2001 - Jun 2017

Position: Principal Consultant

- 2015- : Business Line: Health, Safety & Environmental Compliance Management
- 2011-2014: Business Line: Cleaner Energy Services
- 2007-2010: Business Unit: Technical Operation & Services
- 2001-2007: Business Unit: Power Generation & Sustainables

BLGG AgroXpertus

Mar 1988 - Mar 2001

Position: Manager Innovation & Laboratory Manager (from 1998)

- Conducting research on the basis of projects for the development of laboratory processes. Including derived tasks; formulating the laboratory development policy, economic assessment of projects and processes, automated data processing, development of quality systems and in-house training
- Determining the laboratory targets to be realized and measuring the achievements regarding production and quality. Taking care of the department's financial management concerning the personnel, production and projects.

Detailed professional experience

Projects in, Netherlands, Germany, Norway, Belgium, France, Qatar, Jan 2013 - Mar 2015

Position: Principal Consultant Health, Safety & Environmental Compliance Management

Description: Project management CCS projects, Environmental Impact Assessment, Technology Verification, Uncertainty Assessments

Activities performed: - Secretary to the Environmental Working Group of Dutch Electricity producers, - Monitoring and uncertainty assessment of the emissions of a gypsum producer, - Two flue gas flow measurement Pilots and public Excel tool for quality assurance of direct and indirect flow calculation, - Verification of CO2 annual emission reports for EU-ETS, - Project management for Carbon Capture and Storage projects, - Preliminary Environmental Impact Assessment of a reverse osmosis water plant in

Qatar, - Quality assurance and uncertainty assessment of the Belgian emission inventory, - Verification of emission and emission registration system at waste incinerators, - Technology verification for investment decision in sustainable energy generation and use

Projects in, Germany, Netherlands, Denmark, Jan 2011 - Dec 2013

Position: Consultant and/or Project Leader

Description: Validation of emission reporting systems, uncertainty analysis of CO2 monitoring, Flue gas flow calculation methods, verification for emission trading

Activities performed: - Validation of new emission reporting systems at waste incinerators and oil exploration, - Uncertainty analysis of CO2 monitoring systems for the new 2013-2020 EU-ETS trading period - Emission monitoring during startup and shutdown under the new EU-Industrial Emission Directive, - Verification of CO2 and NOx annual emission reports for EU-ETS and Dutch NOx trading, - Verification of the data report and methodology report for the allocation of CO2 in the 2013-2020 trading period of EU-ETS, - Validated methods for flue gas flow rate calculation with reference to EN 12952-15; VGB Powertech, - Assessment of the Predictive Emission Monitoring Systems on offshore installations; Maersk-oil Denmark, - Permitting cross border networks in relation to monitoring, verification and accounting under EU-ETS; Ministry of Economic Affairs / CATO2 - Alternatives for NOx emission trade, NOx covenant and simplification of NOx monitoring

Projects in, Qatar, Netherlands, Aruba, Jan 2009 - Dec 2010

Position: Consultant and/or Project Leader

Description: Environmental impact study, assessment of EU-Monitoring for Carbon Capture and Storage, Carbon footprinting, CO2 monitoring for projects and emission trade

Activities performed: - Implementation of Corporate Sustainability policy and measures at KEMA, - Setting up and verification of carbon footprints for construction companies, - Verification of CO2 and NOx emissions at industrial installations, - Preliminary environmental impacts assessment for a new nuclear power plant; Kahramaa, Qatar's general electricity and water corporation, - Analysis of the uncertainty requirements for monitoring of CO2 at capture, transport and storage; Ministry of economic affairs / CATO2, - Monitoring plans for emission trade of CO2 SO2 and NOx; coal fired power plants, - Air quality modeling support; Ministry of transportation and municipalities, - "Project Design Document" for verified emission rights of a new windfarm; Water en Energie Company Aruba, - Measurement techniques for PM10 and PM2.5 at refineries; DCMR Environmental Protection Agency, - Guidance document on EN 14181 quality assurance of automatic measurement systems; Dutch power producers, - Course on method validation and measurement uncertainty for laboratories at power plants; Dutch power producers

Projects in, Ireland, Netherlands, Belgium, Jan 2007 - Dec 2008

Position: Consultant and/or Project Leader

Description: Uncertainty and calibration of emission and ambient air monitoring equipment, complex dispersion modeling, quality assessment of environmental reporting

Activities performed: - Measurement uncertainty of the N2O load for the opt-in in the EU emission trading scheme, with supporting software tool. For the European fertilizer production sites of YARA Europe S.A., Belgium, - Quality assessment of wind tunnel experiments and computational fluid dynamics calculations for highways

and city roads; Ministry of Transportation, - Air Quality modelling of airfields, harbors, highways; Dutch EPA, Airport Schiphol, Ministry of Transportation, - Calibration of dust ambient air measurements on the reference method; Port of Rotterdam EPA, - CO2 monitoring uncertainty assessment; ESB Ireland, - Draw up monitoring plans according to the EU monitoring and reporting guidelines for CO2; Nuon Power Generation, - Project leader for the assessment of environmental monitoring at 20 industrial installations under the EU Pollution Release and Transfer Register; Dutch EPA inspection agency, - Validation of monitoring plans; Dutch Emission Authority, - Harmonized protocol for dispersion modelling of pollution from road traffic through wind tunnel experiments; Directorate for Public Works

Projects in, Netherlands, Belgium, Lithuania, Jan 2005 - Dec 2006

Position: Consultant

Description: Air pollution dispersion modelling + quality assurance of automated measurement systems

Activities performed: - Implementation of Predictive Emission Measurement Systems (PEMS) for NOx emission trade; industrial installations, - Courses on Quality Assurance of automated measurement systems; industrial installations, - Implementing the requirements of the EU Air Quality Directives for ambient air monitoring, accreditation and measurement uncertainty in Lithuania; SenterNovem, - NO2 and dust emission modelling at highways, roads, waterways and building locations for assessment of requirements in the EU ambient air quality directives; - Ministry of transportation; Zuidas project in Amsterdam and Schiphol to Almere on air quality around the highways and tunnels including tunnels and mitigation measures, - Impact of dredging the Schelde estuary up to Antwerp on future air quality, - Municipalities; Amsterdam (interrupted roofing over highways), Breda, Nieuwegein, Ede, Apeldoorn, Amersfoort, Apeldoorn, - Project manager for incorporating the KEMA air pollution modelling software in the geonose software of DGMR, - Training Measurement Uncertainty; KEMA Quality, - Devise and formulation of project plans for improvement of air quality in cities and near roads. submitted to the Dutch IPL, Air Quality Innovation Programme; CROW

Projects in, France, Netherlands, Jan 2003 - Dec 2004

Position: Consultant and/or Project Leader

Description: Quality of CO2 monitoring, NOx monitoring plans, emission and energy measurements

Activities performed: - Assessment of the tier approach in the EU monitoring and reporting guidelines for CO2. Uncertainty calculations for various types of installations in EU member states; Dutch Ministry of the Environment, - Validation of CO2 and NOx monitoring protocols in accordance with the EU monitoring and reporting guidelines for greenhouse gas emissions; Dutch Emission Authority, - Project management for drawing up CO2 – NOx monitoring- protocols in the framework of the CO2 – NOx emission trading system; Essent Energy production and industrial installations, - Guidelines and calculation programs for the implementation of the new European standard EN14181 "Quality Assurance of automated emission measurement systems". Working out procedures for using the standard with Predictive Emission Measurement Systems (PEMS) ; Novem, - Project management for drawing up CO2-index measurement protocols. Determination and quality control of the amount of heat, power and fuel for the subsidizing of CO2 free electricity; Essent

sustainable and other combined heat and power plants, - Planning, elaboration and testing of comparative emissions measurements for NO_x at boilers and gas turbines; EdeA, - Inventory, assessment and testing of procedures to establish equivalence of methods for air emission measurement; INERIS (France), - Incorporation and reporting of laboratory investigations for European standardization of air emission methods; CEN/TC 264 "Air Quality", WG16, - Judgment en guidance for random sample survey for the establishment of PCB contamination of transformers in the Netherlands; EnergieNed, - Giving "in-house" courses measurement uncertainty at laboratories. Working out representative analytical methodologies with regard to measurement uncertainty

Project in, Belgium, Netherlands, Apr 2001 - Dec 2002

Position: Consultant

Description: Monitoring and reporting of emission to air and water + training on analysis and uncertainty

Activities performed: - Determination of the continuous air measurement obligations for coal fired power plants under the new Dutch waste incineration decree; Power producers, - Supporting a non-routine analytical laboratory in acquiring the STERLAB accreditation. Assessing the validation of analytical methodologies; Alterra, - Drawing up the annual report regarding the concentrations and annual quantities of NO_x, CO₂ and CO for the annual environmental report of a paper factory. Describing the current data acquisition and monitoring system, the BEES measurements done and the emission characteristics used. Calculating the uncertainties of these characteristics in relation to the emission limit value and minimization of the water injection. - Co-developing and giving the three-day course "Laboratory statistics and measurement uncertainty". Topics: basic statistics, method validation, statistical quality control, reference materials, interlaboratory tests and measurement uncertainty, - Coordinating, co-developing and giving the two-day course "Reliability Environmental Data, Air Emission Monitoring". Subjects: basic statistics, standards and legislation, quality control of automated monitoring systems, determination of annual emissions and uncertainty calculations of annual emissions, - Manual for emission registration to water for a large combustion plant. Definition emission measuring process, data acquisition and calculations and reports & licenses of process water, main cooling water system, drinking- and rainwater., - Update of "GUIDELINE upon setting up and maintaining a continuous emission registration system for SO₂ and NO_x at combustion plants". Completion with two interactive modules for the R&D Contract Internet site. Calculation of the total measurement uncertainties of the components. Evaluation of the suitability of an emission monitor by comparison with a requested measurement uncertainty. Summarizing new European legislation for large incineration plants. Defining the European standards for quality control of continuous emission monitoring systems, - Estimation/calculation of the uncertainty of national yearly emissions of SO₂, NO_x, PM₁₀, VOS en CO₂ from a random sample from industrial companies; National Institute for Public Health and Environment - Department for waste and emissions, the Netherlands