FLUE GAS CLEANING

steinmüller
engineering
The Engineers Company

RELY ON GOOD EXPERIENCES AND MEET YOUR EMISSION REQUIREMENTS

Protection of our natural resources for the sake of future generations motivates us to constantly improve our technical solutions to control the emission limits of industrial facilities. Furthermore, emission limit values for dust, NOx and SO_x for such facilities are constantly being revised by legislation.

WE ARE THE RIGHT TEAM FOR SPECIAL CHALLENGES!

Upgrades to existing flue gas cleaning systems and retrofits of state-of-the-art equipment for sulphur dioxide, nitric oxide, mercury and dust removal are our day-to-day business – and this is reflected in our extensive reference list and by the satisfaction of our customers.

OUR KNOWLEDGE AND EXPERIENCE HELP YOU TO MEET CURRENT ENVIRONMENTAL REQUIREMENTS IN THE MOST COST-EFFECTIVE MANNER!

TURN OUR EXPERIENCE INTO YOUR ADVANTAGE!

CONTACT

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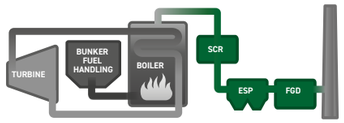
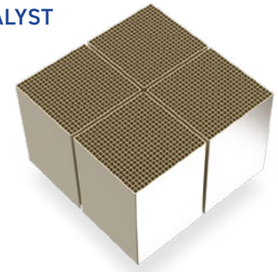
FLUE GAS CLEANING

NOx REDUCTION SYSTEMS



SCR CATALYST



- **RETROFITTED SCR FOR LOW NOx EMISSIONS**

APPLICATION

Power Plants and Industrial Boilers

- Low NOx Burners (LNB)
- Selective catalytic reduction (SCR) with honeycomb catalyst with plate catalyst
- Selective non-catalytic reduction (SNCR) e.g. in the cement industry

Benefits

- Reduction of NOx and NH_3 emissions
- Extension of fuel range
- High availability
- Increase of operational flexibility

Reduced NH_3 consumption

TECHNICAL DATA

Emissions:

- NOx < 50 mg/m³ (STP)
- NH_3 slip < 1 mg/m³

FUEL TYPE

- Bituminous coal
- Heavy fuel oil & residues
- Waste/Sludge
- Lignite
- Biomass co-firing

SCOPE OF SUPPLY

- Consultancy
- Process engineering

Mechanical design

- CFD simulations
- Supply & Installation

Optimization between LNB and SCR / SNCR

- Adaptation of boiler and water-steam cycle
- Adaptation of heating surfaces
- Optimization of flue gas distribution and NH_3 injection
- Commissioning
- Licensing

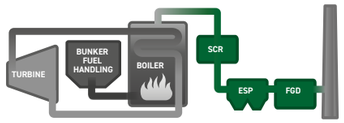
REFERENCE LIST EXCERPT

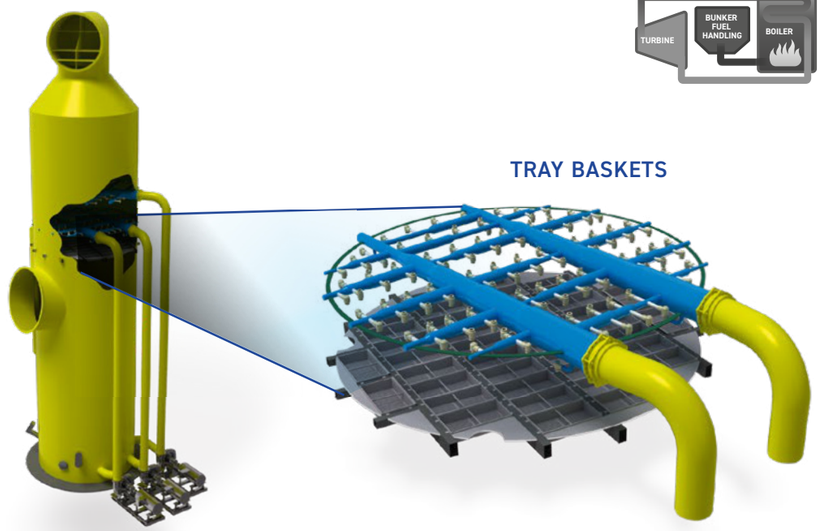
REFERENCE	CLIENT
Feasibility study for retrofit of an SCR plant, Heide Refinery, Germany	Raffinerie Heide GmbH, Hemmingsedt, Germany
Study for upgrade options of air pollution control equipment in answer to BREF 2017, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria	ContourGlobal Maritsa East 3, Sofia, Bulgaria
Feasibility study for co-firing of petcoke, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany	Shell Deutschland Oil GmbH, Wesseling, Germany
Engineering and supply of an SNCR test plant to optimize the existing SNCR, Cement Plant Rüdersdorf, Germany	CEMEX Zement GmbH, Rüdersdorf, Germany
Concept design study: assessment, comparison and selection of feasible NOx reduction technologies and concept engineering for a total of 10 bituminous coal fired power stations, South Africa	Eskom Enterprises, Johannesburg, South Africa
Supply and implementation of a new oil and gas firing system at a steam generator plus retrofit of a catalytic DeNOx system, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Wesseling, Germany	Shell Deutschland Oil GmbH, Wesseling, Germany
License and know-how transfer agreement for catalytic DeNOx system, China	Guizhou XingYun Environment Protection Co. Ltd., Guiyang, P.R. of China
Owner's engineering for 3 SCR installations, modification of 5 steam generators, 75 t/h, 110 t/h, 150 t/h, firing Refinery Residues, Oil and Gas, Mineral Oil Refinery Oberrhein (MIRO), Germany	MIRO Karlsruhe, Germany
Engineering and retrofit of an SCR-DeNOx plant, 200 t/h, Heavy Fuel Oil and Low-Pressure Gas, Shell Rheinland Refinery, Germany	Shell Deutschland Oil GmbH, Wesseling, Germany

LEGEND

BAT	Best Available Technology	CHP	Combined Heat & Power Plant	SCR	Selective Catalytic Reduction
BREF	BAT Reference Documents	ESP	Electrostatic Precipitator	STP	Standard Temperature and Pressure
CFB	Circulating Fluidized Bed	FGD	Flue Gas Desulphurization	PS	Power Station

WET FLUE GAS DESULPHURIZATION SYSTEMS





TRAY BASKETS

- **FLEXIBLE MODULAR SYSTEM FOR RETROFIT**
- **INCREASE OF REMOVAL EFFICIENCY**
- **REDUCTION OF POWER CONSUMPTION**

APPLICATION

Fields of Application

- Power plants
- Industrial plants

Benefits

- Reduction of pollutant emissions (SO_2, SO_3, mercury, dust)
- Increase of operational flexibility
- Optimized consumption of limestone
- Optimized distribution of oxidation air
- Reduction of auxiliary energy consumption

TECHNICAL DATA

- SOx < 100 mg/m³ (STP) corresponding to removal efficiencies > 99 %
- Dust < 3 mg/m³ (STP)
- Upgrade with neutral pressure drop design possible

FUEL TYPE

- Bituminous Coal
- Lignite
- Biomass co-firing
- Waste/Sludge
- Oil

SCOPE OF SUPPLY

Retrofit, Revamping and New-Built FGDs

- Supply & installation (EPC) of tray for BREF compliance
- Process engineering ▪

CFD simulations

- Mechanical design
- EP for core process equipment
- Optimization concepts
- Commissioning

REFERENCE LIST EXCERPT

REFERENCE	CLIENT
Engineering for optimization of absorber, 5.2 MWel, Sewage Sludge, Hamburg Wasser, Germany	Hamburg Stadtentwässerung AöR, Hamburg, Germany
Detail engineering and supply of 23 additional tray baskets, 480 MWel, Bituminous Coal, Mannheim PS Unit 8, Germany	Grosskraftwerk Mannheim AG, Mannheim, Germany
Engineering and supply of a tray level for wet FGD, 22 MWth, Herten Waste-to-energy plant Unit IM 1, Germany	AGR Betriebsführung GmbH, Herten, Germany
Study of upgrade options for air pollution control equipment in answer to BREF 2017 Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria	ContourGlobal Maritsa East 3, Sofia, Bulgaria
Engineering for the conversion of absorber from lime to limestone, 35 t/h, Lignite, Plant Brottewitz, Germany	Südzucker Plant Brottewitz, Germany
Licence for dry CFB-FGD technology, 6 x 686 MWel, Bituminous Coal, Kendal PS, South Africa	Eskom Enterprises, Johannesburg, South Africa
Retrofit of a tray for FGD scrubber upgrade, 2 x 110 MWel, Lignite, Novaky PS, Slovakia	Slovenske elektrarne a.s., Bratislava, Slovak Republic
Feasibility study for the retrofit of a flue gas desulphurization plant, 3 x 50 MWel, Bituminous Coal, International Paper Kwidzyn, Poland	International Paper Kwidzyn Sp. z.o.o., Kwidzyn, Poland
Retrofit of a tray for FGD scrubber upgrade, 86 MWel, Lignite, Deuben PS, Germany	Mitteldeutsche Braunkohle-gesellschaft GmbH, Germany
Retrofit of a tray for FGD scrubber upgrade, 600 t/h, Fenne PS, Bituminous Coal, Völklingen, Germany	Steag AG Saar-Völklingen, Germany
Engineering and key component supply for a Wet FGD, 150 MWel, Lignite, Paroseni PS, Romania	LAB GmbH, Germany for Electro-centrale Paroseni S.A., Romania
FGD Tender evaluation, 6 x 800 MWel, Bituminous Coal, Kusile PS, South Africa	Eskom Enterprises, Johannesburg, South Africa

LEGEND

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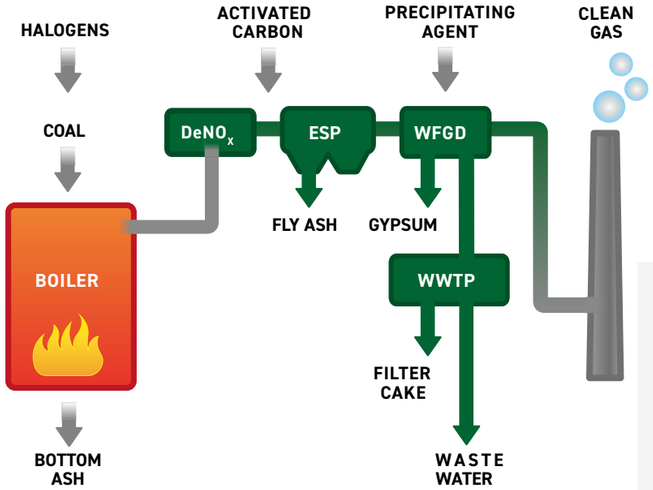
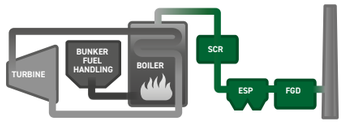
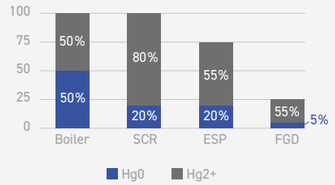
MERCURY REMOVAL





Hg PARTITIONING IN FLUE GAS DOWNSTREAM OF

(TOTAL Hg AFTER BOILER = 100 %)



- **REMOVAL EFFICIENCY INCREASE**
- **BEST AVAILABLE TECHNOLOGY**

APPLICATION	AVAILABLE TECHNOLOGIES	SCOPE OF SUPPLY

Fields of application
▪ Thermal power plants
▪ Waste incineration plants
Scope of application
▪ Mercury balance assessments with own on-line mercury analyzers
▪ Integrated engineering solutions
Benefits
▪ Increase of operational flexibility
▪ Reduction of mercury emissions
▪ Proven and robust technologies
	▪ Adsorption with activated carbon
	  ▪ Duct injection
	  ▪ Low pressure moving bed (patent pending)
	▪ Separation in the flue gas desulphurization process
	  ▪ Tray (reduction of mercury re-emission)
	  ▪ Adding precipitating or complexing agent
		▪ Mercury measurements and speciation
		▪ Consultancy and optimization concepts
		▪ Process engineering
		▪ Engineering, supply and installation of components

REFERENCE LIST EXCERPT

REFERENCE	CLIENT
Recording of mercury removal in correlation to SO_2 removal. Assessment of sources and sinks of mercury, 530 t/h, Bituminous Coal, CHP Fenne, Völklingen, Germany	STEAG AG, Saar-Völklingen, Germany
Switch of neutralizing agent in the FGD and evaluation its reper-cussion on mercury removal, 35 t/h, Lignite, Plant Brottewitz, Germany	Südzucker Werk, Brottewitz, Germany
Assessment of chemical heavy metal precipitation and correspond-ing adjustment of the absorber water cycle, 750 MWel, Bituminous Coal, Mehrum PS, Germany	KW Mehrum GmbH, Hohenhameln, Germany
Increase of the SO_2 capture in the second stage of a two-stage wet scrubber without negative effects on the overall mercury removal rate, 5.2 MWel, Vera Hamburg, Germany	Hamburg Stadtentwässerung AöR, Hamburg, Germany
Increase of SO_2 capture in a two-stage wet FGD scrubber without reducing mercury removal rate, 22 MWth, Herten Waste-to-energy plant, Germany	AGR Betriebsführung GmbH, Herten, Germany
BREF impact study and concept development on mercury removal in the FGD, Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria	ContourGlobal Maritsa East 3, Sofia, Bulgaria
Petcoke (co-)combustion study, quantification of the corresponding increase In heavy metals´ concentrations, 200 t/h, Heavy Fuel Oil and Low-Pressure-Gas, Shell Wesseling, Germany	Shell Deutschland Oil GmbH, Wesseling, Germany
Consulting & engineering support to assess sources and sinks of mercury in the power plant, Lignite, 188 MWth, Amsdorf PS, Germany	Romonta GmbH, Seegebiet Mansfelder Land, Germany
Consulting and engineering support to assess sources and sinks of mercury in the power plant, 11x250 MWel, Lignite, Jänschwalde PS, Germany	Lausitz Energie Kraftwerk AG, Cottbus, Germany

LEGEND

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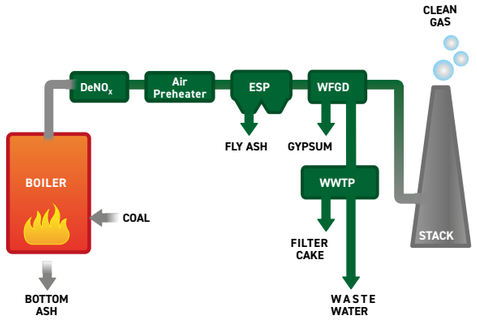
MERCURY MONITORING AND MASS BALANCING



- PORTABLE CONTINUOUS MONITORING
- CLOSING OF MERCURY BALANCE
- MERCURY REMOVAL CONCEPTS

APPLICATION

Fields of Application

- Speciation and quantification of elemental, oxidized and particulate mercury
- Testing of permanent emission monitoring systems (single probes and long term)
- Plausibility checks
- Testing of influencing parameters (fast response time)

Benefits

- Portable modular design
- Quick and easy transport
- Integrated calibration

TECHNICAL DATA

- High sensitivity: 0.05 µg/m^3
- Fast response: t(90) = 180 s
- Calibration certified (U.S. National Institute of Standards and Technology)

FOCUSSED FUEL TYPES

- Bituminous Coal
- Lignite
- Waste
- Sludge
- Oil

SCOPE OF SUPPLY

- Analyzer rental
- Measurement planning & execution
- Remote monitoring possible
- Consulting
  - Closing of mercury balance
  - Plant specific mercury removal concepts (choice of removal technologies)
- Engineering assistance, e.g. feasibility studies

REFERENCE LIST EXCERPT

REFERENCE	CLIENT
Recording of mercury removal in correlation to SO_2 removal. Assessment of sources and sinks of mercury, 530 t/h, Bituminous Coal, CHP Fenne, Völklingen, Germany	STEAG AG, Saar-Völklingen, Germany
Switch of neutralizing agent in the FGD and evaluation its reper-cussion on mercury removal, 35 t/h, Lignite, Plant Brottewitz, Germany	Südzucker Werk, Brottewitz, Germany
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Consulting and engineering support to assess sources and sinks of mercury in the power plant, 11x250 MWel, Lignite, Jänschwalde PS, Germany	Lausitz Energie Kraftwerk AG, Cottbus, Germany

LEGEND

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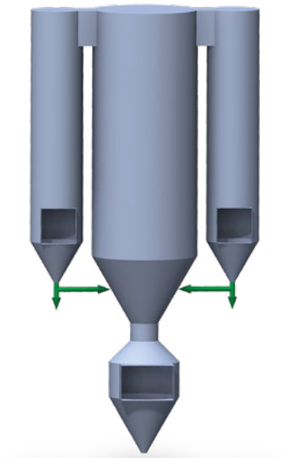
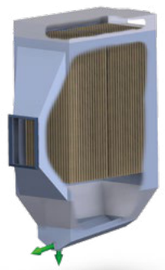
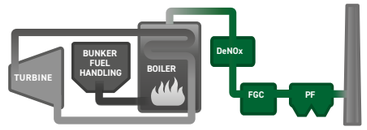
DRY FLUE GAS CLEANING SYSTEMS

CFB-FLOW REACTOR



PROCESS FILTER (PF)





- ULTRA HIGH POLLUTANT REMOVAL RATES
- HIGH AVAILABILITY
- MINIMUM PLANT AREA
- LOWEST WATER AND SORBENT CONSUMPTION

APPLICATION

Fields of use

- Coal fired boiler plants
- Heavy fuel oil fired boiler plants
- Refinery residue fired boiler plants
- Biomass boiler (incl. Bio-mass-waste) plants
- Waste, Refuse-Derived-Fuel (RDF) and sewage sludge incineration plants
- Process flue gases from
  - Aluminium industry (e.g. electrolysis off gases)
  - Steel industry (e.g. sinter plant off gases)
  - Cement industry (e.g. process gases)

TECHNICAL DATA

Simultaneous emission reduction for

- SO_2 < 200 / < 10 mg/m³ (STP)
- SO_3 < 1 mg/m³ (STP)
- HCl < 1 mg/m³ (STP)
- HF < 1 mg/m³ (STP)
- Hg < 1 µg/m³ (STP)
- Dust < 2 mg/m³ (STP)

SCOPE OF SUPPLY

New-built FGCs and retrofit

- Consultancy
- Licensing
- Project management
- Process engineering
- Basic engineering
- Detail engineering
- Supply & installation
- Commissioning

BENEFITS

- Compact design with low plant area requirements
- 10.000 to 4.500.000 m³/h with a single reactor
- High availability > 98 %
- High turn down ratio
- Flexibility in utilization of absorbents
- Low water consumption incl. wastewater
- Fuel flexibility e. g. SO_2 reduction from 8.000 mg/m³ (STP) down to below 200 mg/m³ (STP)
- Fuel flexibility e. g. HCl reduction from 2.000 mg/m³ (STP) down to below 10 mg/m³ (STP)
- No additional operator staff
- Low maintenance and spare parts

REFERENCE LIST EXCERPT

REFERENCE	CLIENT
License for Dry CFB-FGD technology, 6 x 686 MWel, Bituminous Coal, Kendal PS, South Africa	STEINMÜLLER ENGINEERING GMBH for (Eskom Enterprises, Johannesburg, South Africa)
License for Dry CFB-FGD technology, coal and coal with secondary fuels fired plants, Poland	INSTAL-FILTER SA, Kościan, Poland
Basic and detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 185 MWth	INSTAL-FILTER SA, Kościan, Poland for (ENERGETYKA Group KGHM, Lubin, Poland)
Basic-, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 181 MWth	INSTAL-FILTER SA, Kościan, Poland for (ENERGETYKA Group KGHM, Polkowice, Poland)
Basic-, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 82 MWth	INSTAL-FILTER SA, Kościan, Poland for (Energetyka Cieplna Sp. z o.o., Skierniewice, Poland)
Basic-, detail engineering, procurement and supply including installation and commissioning of 2x flue gas desulphurization and de-dusting plants, 81 MWth.	INSTAL-FILTER SA, Kościan, Poland for (Miejskie Przedsiębiorstwo Energetyki Cieplnej Sp. z o.o., Włocławek, Poland)
Consultancy, engineering, supply and advisory service for optimization of a water injection system upgrade for a flue gas cleaning and de-dusting plant.	Solvay Chemicals GmbH, Rheinberg, Germany

BEYOND THAT

More than 70 GRAF-EnviroPro-team reference plants with previous Dry-CFB-FGC technology & Process Filter for almost any fuel from 10.000 to 3.500.000 m³/h with a single reactor.

LEGEND

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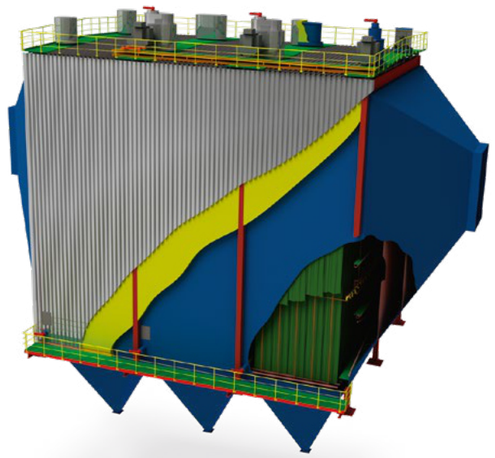
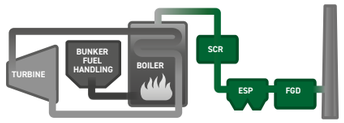
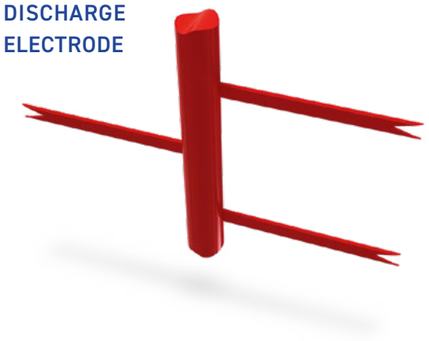
DUST REMOVAL SYSTEMS





DISCHARGE ELECTRODE



▪ **LOW DUST EMISSIONS** ▪
HIGH EFFICIENCY
▪ **REDUCTION OF POWER CONSUMPTION**

APPLICATION

Power Plants and Industrial Boilers

- Dry electrostatic precipitator
- Fabric filters also in combination with dry FGD (CFB-FGD)
- Wet electrostatic precipitator

Benefits

- Reduction of dust emissions
- Extension of fuel range
- Upgrade of ESPs within existing footprint and structure
- Energy savings through optimized high voltage supply
- High availability
- Increase of operational flexibility

TECHNICAL DATA

Emissions:

- Dust < 8 mg/m³ (STP)
- In combination with Wet FGD upgrades: Dust < 3 mg/m³ (STP)

FUEL TYPE

- Bituminous coal ▪ Lignite
- Biomass co-firing
- Waste/Sludge
- Oil

SCOPE OF SUPPLY

Retrofit, Revamping and New-Built

- Consultancy (e.g. for BREF compliance)
- Process engineering
- Mechanical design
- CFD simulations of flue gas path and flow optimization
- Supply & installation ▪ Optimization concepts ▪ Commissioning
- Licensing

REFERENCE LIST EXCERPT

REFERENCE	CLIENT
Study of upgrade options for dust removal system (ESP versus FGD tray) in answer to BREF 2017	SLOVNAFT, a.s., Bratislava, Slovak Republic
Study of upgrade options for air pollution control equipment in answer to BREF 2018 Lignite, 227 MWel, Maritza East 3, Maritza, Bulgaria	ContourGlobal Maritsa East 3, Sofia, Bulgaria
CFD calculations flow optimization, Milazzo Refinery, Italy	Raffineria di Milazzo S.C.p.A., Milazzo, Italy
Retrofit of TR sets and control equipment for electrostatic precipitator, 166,000 m³/h (STP), Milazzo Refinery, Italy	Raffineria di Milazzo S.C.p.A., Milazzo, Italy
Boiler and ESP design study and know-how transfer for 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa	Eskom Enterprises, Johannesburg, South Africa
Rehabilitation and optimization of ESP, 610,000 m³/h (STP), Lignite, Govora PS, Romania	CET Govora, Râmnicu Vâlcea, Romania
Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 166,000 m³/h (STP), Milazzo Refinery, Italy	Raffineria di Milazzo S.C.p.A., Milazzo, Italy
Rehabilitation of electrostatic precipitator behind fluidized catalytic cracker plant (FCC), 90,000 m³/h (STP), BP Refinery Gelsenkirchen, Germany	Ruhr Oel GmbH, Gelsenkirchen, Germany
Concept engineering study for the optimization of ESPs, 6 x 600 MWel, Bituminous Coal, Tutuka PS, South Africa	Eskom Enterprises, Johannesburg, South Africa
CFD flow simulation and optimization for ESP downstream pyrite roaster in sulphuric acid plant, 30,000 m³/h (STP), Haldor Topsoe Plant, Denmark	Ion Blast Ltd., Helsinki, Finland
CFD flow simulation for ESP, shale oil plant, 119,000 m³/h (STP), Eesti Energia Narva, Estonia	Ion Blast Ltd., Helsinki, Finland

LEGEND

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RELY ON GOOD EXPERIENCES

YOU CAN COUNT ON US AS EXPERTS IN THE AREAS OF

- **COMBUSTION & INCINERATION**
- **AIR POLLUTION CONTROL**
- **HEAT TRANSFER & STORAGE**
- **ENGINEERING & CONSULTING**
- **AFTER SALES**

ALLOW US TO ASSIST YOU IN YOUR EFFORT TO MEET UP-TO-DATE ENVIRONMENTAL DEMANDS WHILE REMAINING ECONOMICALLY EFFICIENT!

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