



„The Tray Absorber Technology for new FGD Plants and Retrofits of Coal Fired Power Plants“

Energetyka Belchatow 2013

9. – 11. September, 2013

Bilfinger Berger SE

**Industrial
Services**

**Power
Services**

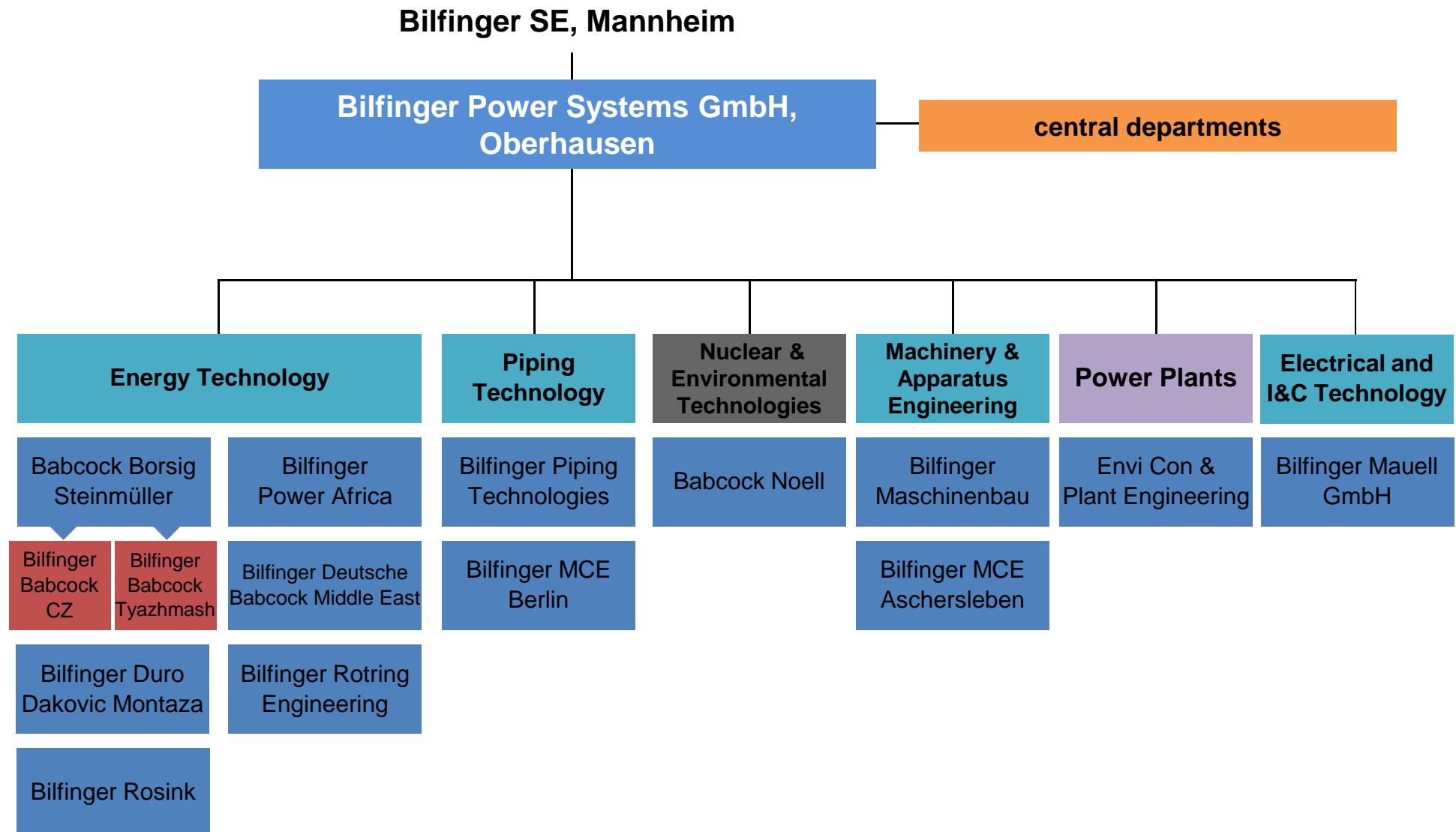
**Building and
Facility Services**

Construction

Concessions

Bilfinger SE (Shareholder)

Structure of BPS



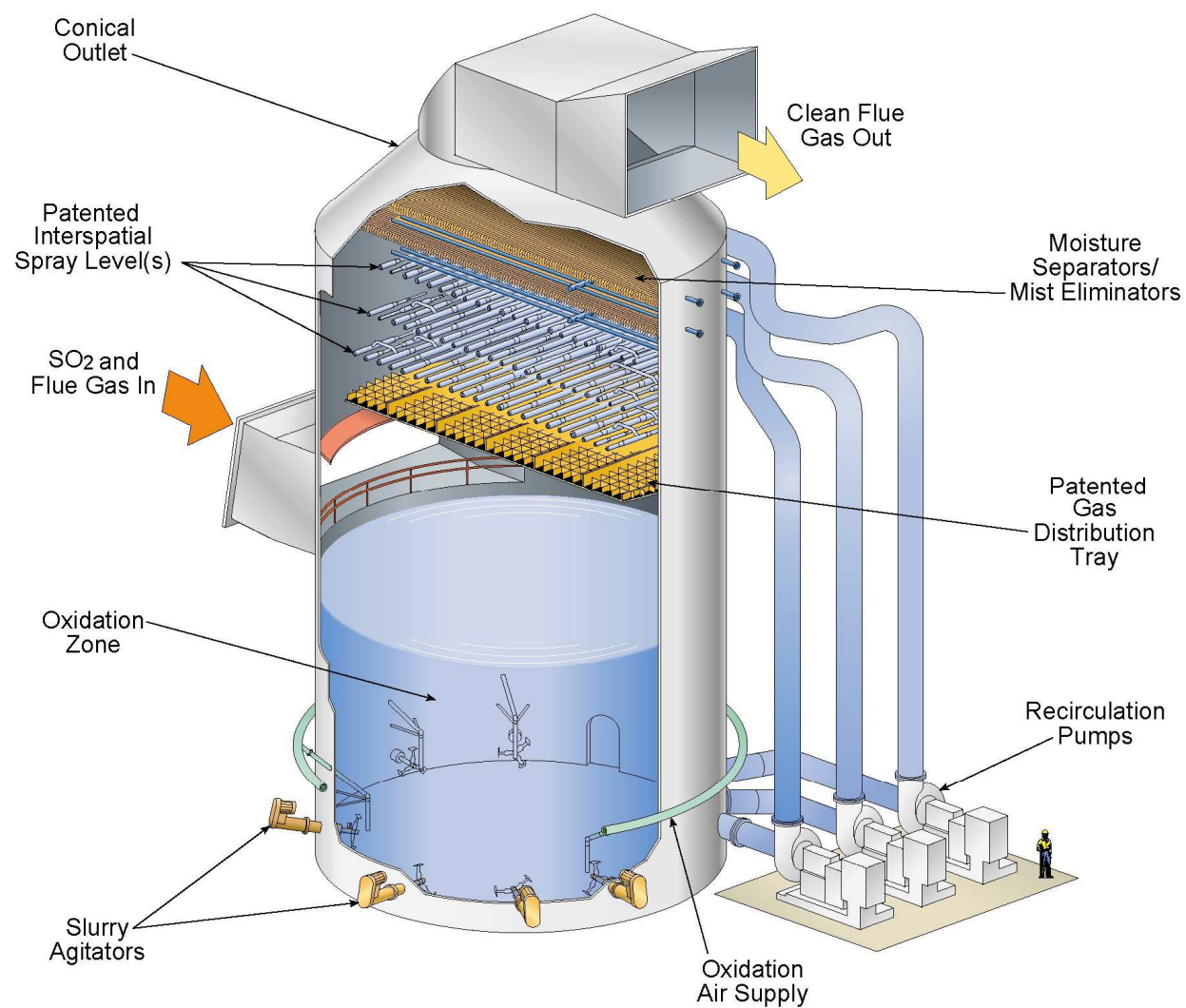


- Design, engineering, delivery, complete installation and commissioning of Flue Gas Cleaning Systems:
 - wet / dry FGD
 - DeNOx
 - Filter (ESP, Bag Filter)
- Computational Fluid Dynamics (CFD) studies for flue gas systems
- Process Optimisation and Retrofitting / Upgrading of existing Flue Gas Cleaning Systems

Babcock Noell GmbH – The Tray-Absorber

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Babcock Noell GmbH



The Tray

The Tray consists of a perforated sheet, which is located directly above the flue gas inlet.

The slurry together with the flue gas forms a very intensive turbulence above the Tray,

a hold-up time of the slurry,

which both significantly improves the mass transfer of the SO_2 .



FGD Boxberg Unit R



Scope:

Planning, construction, delivery, installation and commissioning of the FGD

consisting of:

Absorber system, steel works, limestone slurry transport and dosing system, gypsum dewatering system

Technical Data:

| | |
|---------------------------------------|--------------------------------|
| Power per boiler unit: | 670 MW |
| flue gas flow: | 2.600.000 Nm ³ /h |
| fuel: | lignite |
| SO ₂ -inlet concentration: | 8.400 mg/Nm ³ , dry |
| SO ₂ - removal: | 97,5 % |
| number of absorber: | 1 |

Location: Boxberg, Saxonia

Date of order: October 2005

Commissioning: January 2012

Hand over: October 2012

Client: Vattenfall Europe
Generation AG

Vom-Stein-Strasse 39
D- 03050 Cottbus

FGD Power Plant Boxberg Unit R

Flue gas inlet duct

material: Alloy 59 clad



FGD Power Plant Boxberg Unit R



- Absorber sump (rubber lining)
- Absorber internals (flue gas inlet duct and strainers)

FGD Power Plant Boxberg Unit R

The Tray (view in flue gas flow direction)



FGD Power Plant Boxberg Unit R

Absorber recycle pumps



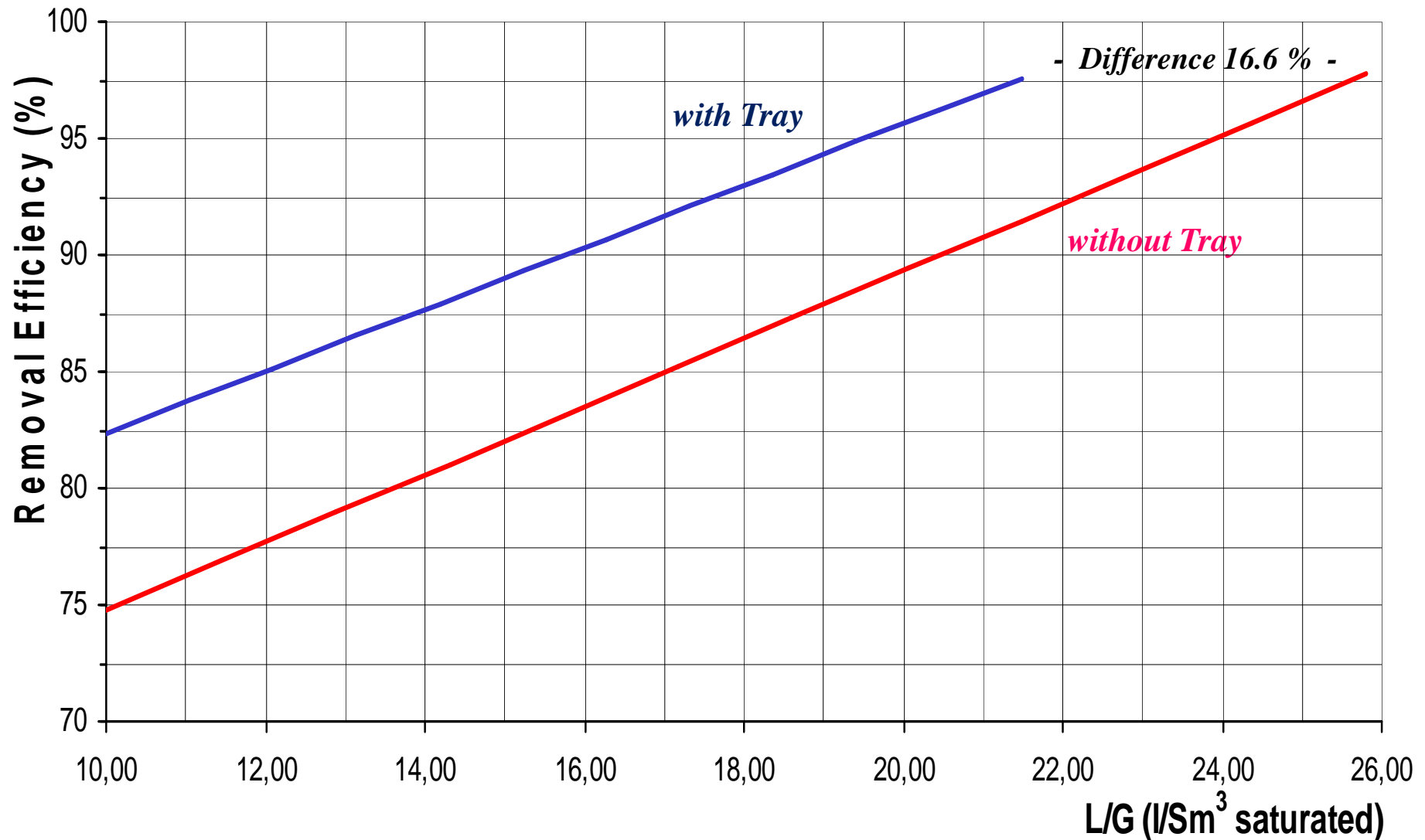
FGD Power Plant Boxberg Unit R

Spray Header and Tray

Tray elements in stainless steel 1.4562



SO₂ - Removal Efficiency with and without Tray



FGD Moorburg Units A & B

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Scope:

Planning, construction, delivery, installation and commissioning of the FGD

consisting of:

2 Absorber Systems with stacks on top, flue gas ducts, steel works, limestone preparation and dosing system, gypsum dewatering system

Technical data:

| | |
|---------------------------|--------------------------------|
| Number of units: | 2 |
| power per boiler unit: | 820 MW |
| flue gas per unit: | 2.276.000 Nm ³ /h |
| fuel: | hard coal |
| SO ₂ -inlet | 3.950 mg/Nm ³ , dry |
| SO ₂ - removal | 97,5 % |
| number of Absorber: | 2 |
| location: | Hamburg-Moorburg, Germany |

Date of order: March 2006

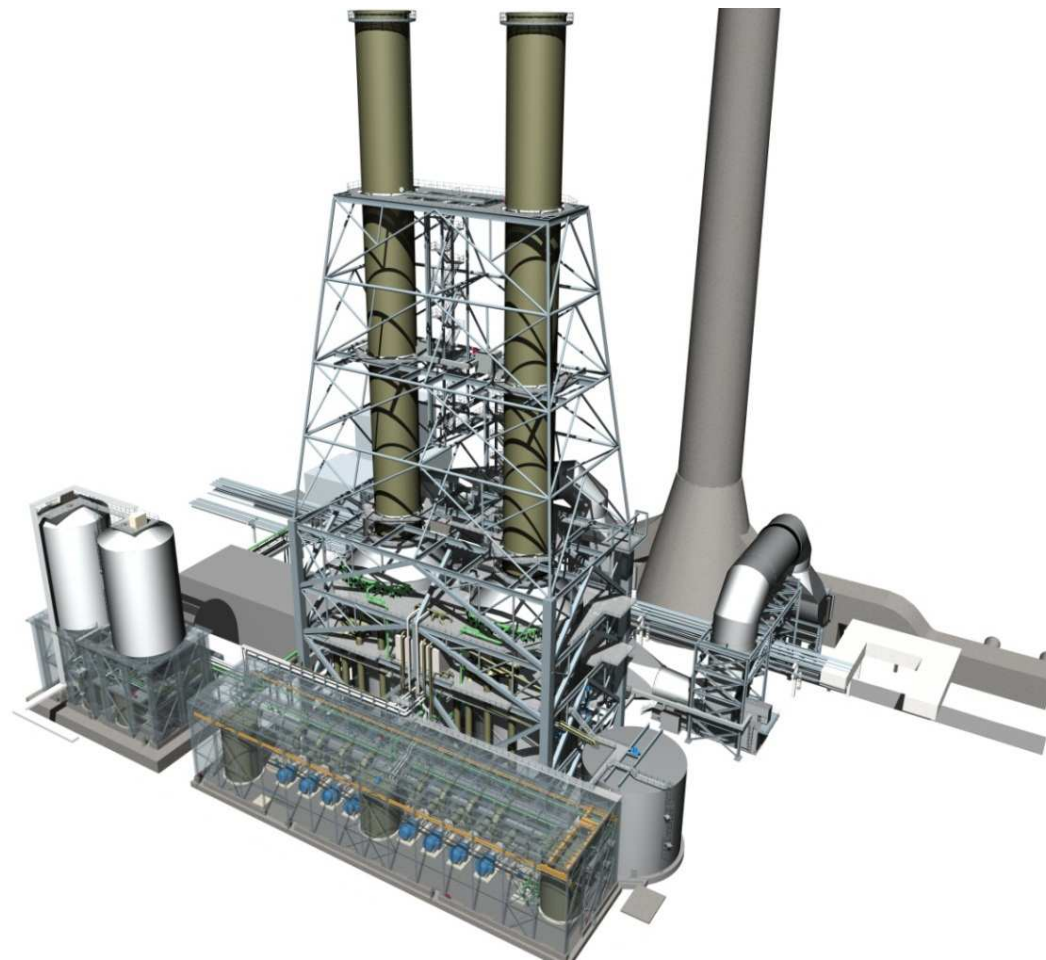
End of erection: December 2011

Commissioning: Unit A: July 2013
Unit B: February 2013

Client: Vattenfall Europe Generation AG
Vom-Stein-Strasse 39
D- 03050 Cottbus



Flue Gas Desulphurisation Plant Isalnita Power Plant (Romania) Units 7 & 8



Scope :

Engineering, design, delivery, installation and commissioning of a FGD consisting of:

2 Absorbersystems , chimneys placed directly on top, civil works, ducts, steel structure, 2 ID-fans, centrale lime stone supply, gypsum slurry discharge system

Technical Data:

| | |
|--|--------------------------------|
| No. units: | 2 |
| Unit size: | 315 MW |
| Amount of flue gas per unit: | 2.080.000 Nm ³ /h |
| Fuel: | Lignite |
| SO ₂ – inlet concentration: | 5.543 mg/Nm ³ , dry |
| SO ₂ – removal efficiency: | 97,4 % |
| Number of Absorbers: | 2 |

Location: Isalnita (close to Craiova), Romania

Receipt of order: August 2011

Commissioning: Spring 2014

Client: S.C. Complexul Energetic Craiova S. A.
str. Unirii nr. 147 jud. Dolj
Craiova, Romania

Flue Gas Desulphurisation Plant Isalnita Power Plant (Romania) Units 7 & 8

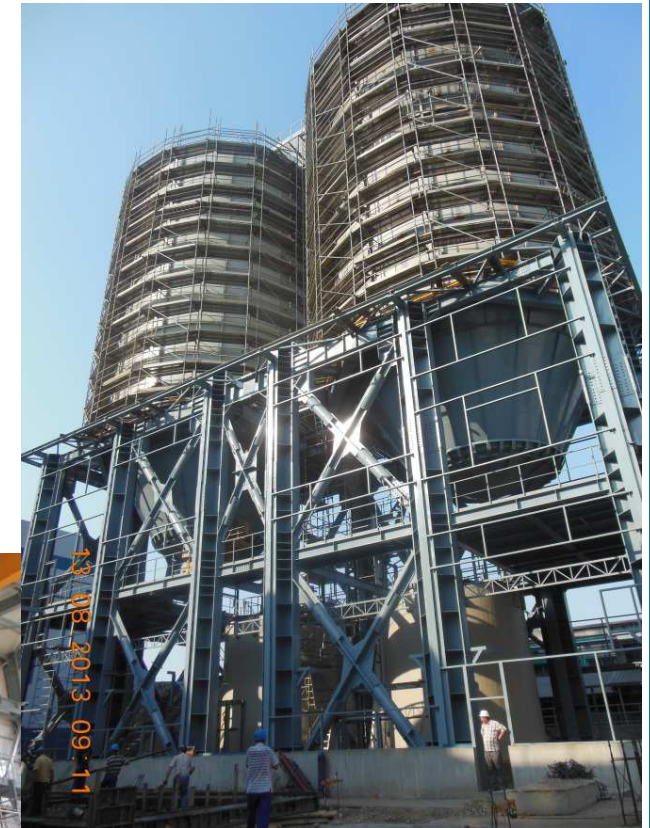
Status of Erection August 2013



**2 Absorbers with steel
structure for the stacks**



Absorber recycle pumps

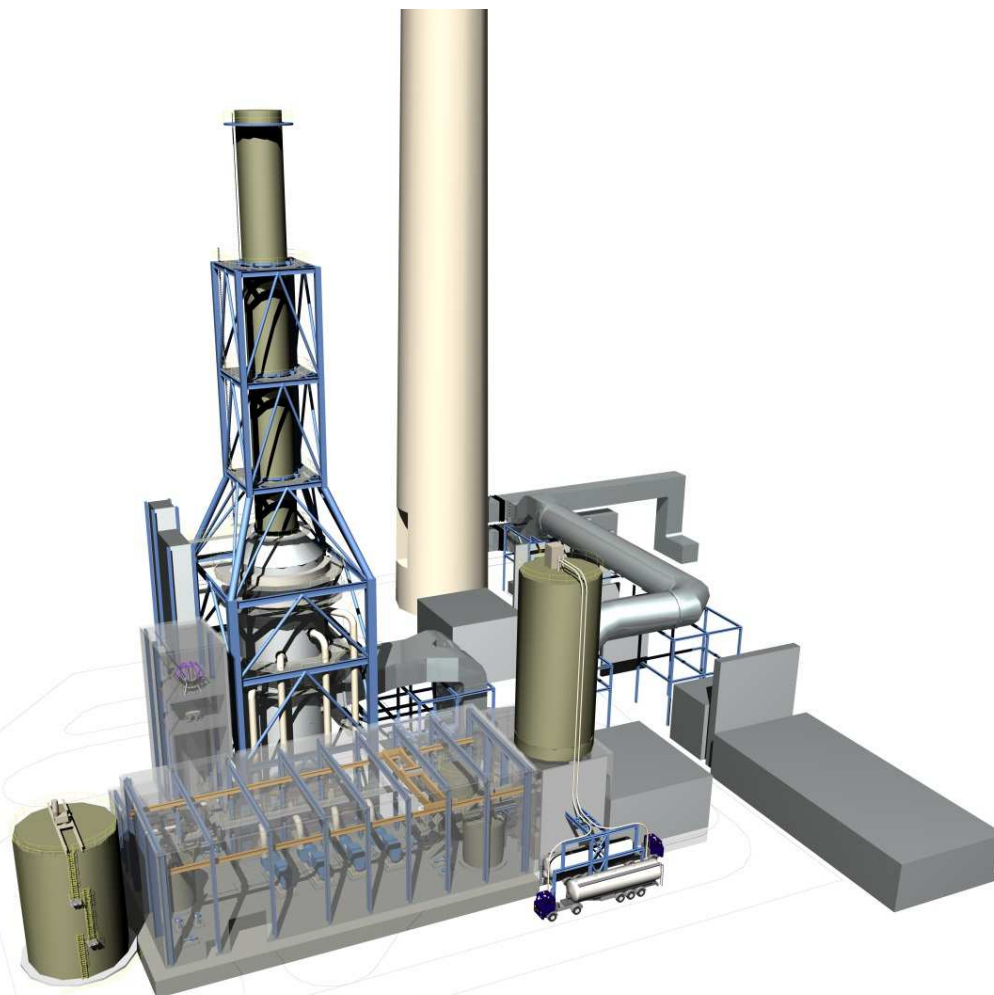


**2 Limestone silos with
slurry tanks**

Govora Power Plant (Romania)

Unit 7

Flue Gas Desulphurisation Plant (FGD)



Scope :

Engineering, design, delivery, installation and commissioning of a FGD consisting of:

1 Tray-Absorbersystem , chimneys placed directly on top,
civil works, ducts, steel structure, 2 ID-fans,
lime stone supply, gypsum slurry discharge system

Technical Data:

| | |
|--|--------------------------------|
| No. units: | 1 |
| Unit size: | 420 t/h steam |
| Amount of flue gas per unit: | 760.000 Nm ³ /h |
| Fuel: | Lignite |
| SO ₂ – inlet concentration: | 6.975 mg/Nm ³ , dry |
| SO ₂ – removal efficiency: | 97,5 % |
| Number of Absorbers: | 1 |

Location: Govora, Ramnico Valcea
Romania

Receipt of order: May 2013

Commissioning: December 2015

Client: JUDETUL VALCEA (CONSILIUL JUEDTAN VALCEA)
RM. VALCEA
STR: GENERAL PRAPORGESCU NR. 1-T
România

FGD Oxyfuel Pilotplant Schwarze Pumpe

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Absorber with flue gas cooler upstream

Tray - Absorber

Installation of 1 - 3 Trays possible

- SO₂ inlet 12.000 mg/Nm³ dry
- removal efficiency > 99 %
- diameter 1,5 m
- height 16,5 m
- separate oxidation tank
- product: gypsum slurry

(utilized at Schwarze Pumpe FGD)

Enlargement of Mass Transfer by Installation of the Tray

Oxyfuel - Absorber without TRAY

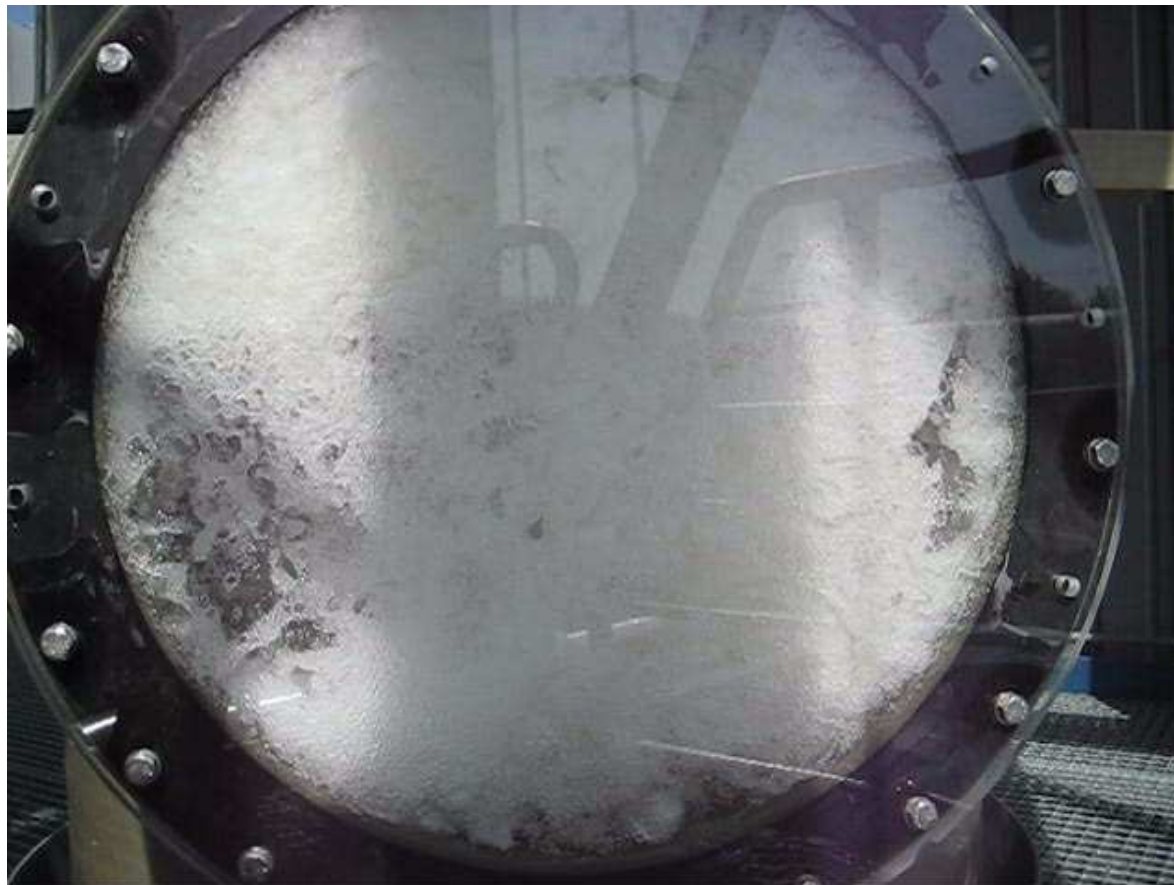
Example FGD Oxfuel Pilot Plant Schwarze Pumpe



Enlargement of Mass Transfer by Installation of the Tray

Oxyfuel - Absorber with TRAY

Example FGD Oxfuel Pilot Plant Schwarze Pumpe



Provisions for Upgrading of existing FGD systems

The following measures can be carried out in order to increase the SO₂ separation of the existing absorbers:

Optimising of the nozzle equipment

Increasing the l/g ratio (liquid/gas)

internals for suppressing the wall effect

Installation of a tray

With the existing pressure reserves of the installed fans, the installation of the tray represents the most effective solution.

Retrofit Options of the Tray in various Absorber Systems

Absorber Unit 1 HKW 1, Altbach



Scope of Supply:

Optimisation of a double loop absorber by replacement of the existing wet film contact by a Tray, including design, delivery, installation and commissioning

Technical data:

| | |
|----------------------|----------------------------|
| Number of units: | 1 |
| Unit size: | 420 MW |
| Amount of flue gas: | 800.000 Sm ³ /h |
| Fuel: | Hard coal |
| Dust in clean gas: | < 15 mg/Sm ³ |
| Number of Absorbers: | 1 |

Location: Altbach/Deizisau

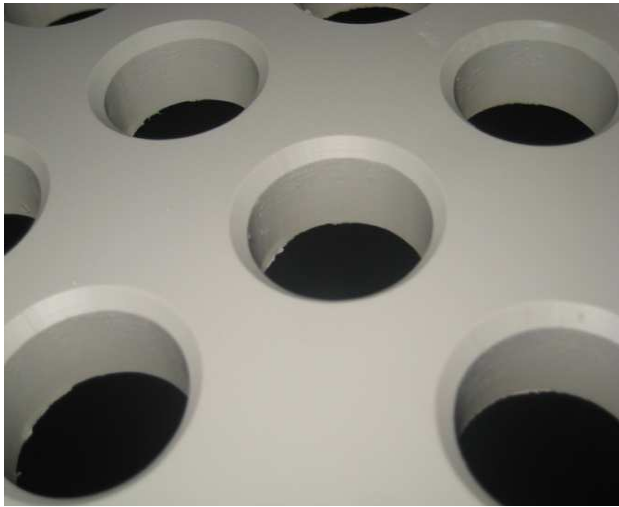
Receipt of order: March 2008

Commissioning: June 2008

Hand over: 2009

Client: EnBW Kraftwerk AG
Heizkraftwerk
Altbach/Deizisau
Industriestraße 11
73776 Altbach

The Tray made of Polypropylen (PP)



The tray in PP design



Flue Gas Desulphurisation Power Plant Ingolstadt Unit 4



Scope of Supply:

Optimisation of a double loop absorber by replacement of wet film contact by tray, incl. design, delivery, installation and commissioning

Technical data:

| | |
|---|---|
| Number of units: | 1 |
| Unit size: | 460 MW |
| Amount of flue gas: | 1.300.000 Sm ³ /h |
| Fuel: | Heavy-fuel oil („special quality“) |
| Required SO ₂ -removal efficiency: | up to 3.000 mg/Sm ³ > 98,5 % up to 4.500 mg/Sm ³ > 98,0 % up to 5.500 mg/Sm ³ > 97,5 % |
| Dust in clean gas: | < 10 mg/Sm ³ |
| Number of absorbers: | 1 |
| Location: | Ingolstadt |
| Receipt of order: | January 2009 |
| Commissioning: | October 2009 |
| Hand over: | 2009 |
| Client: | E.on Kraftwerk Ingolstadt Bayernwerkstraße 30 D-85098 Großmehring |

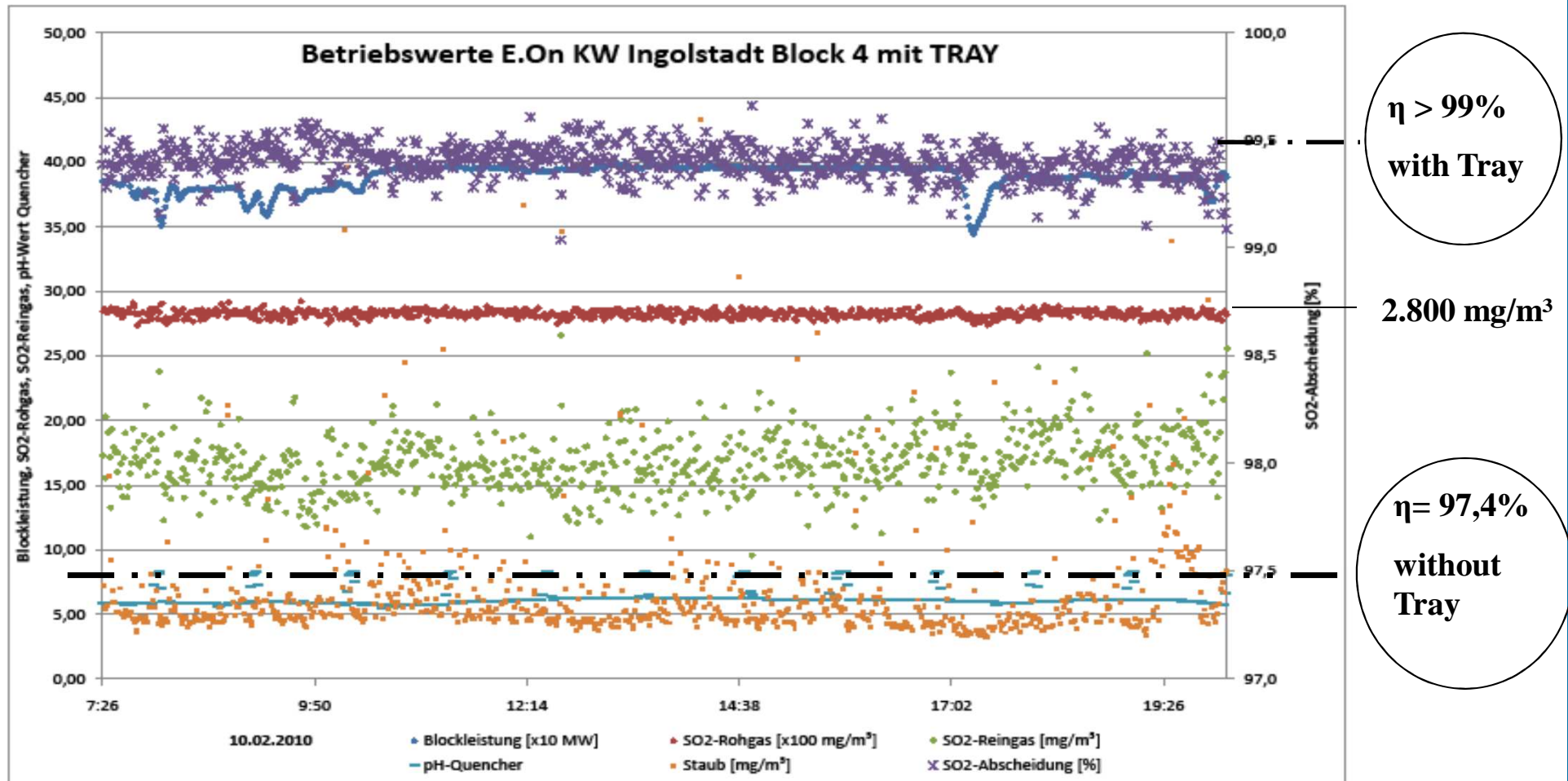
The Tray at the FGD in Ingolstadt material 1.4435

Absorber internals after six months of service



Retrofit options of the Tray in various Absorber Systems

Process data Power Plant Ingolstadt unit 4, E.ON - Tray in operation



Increase in SO₂ efficiency from 96,5% to > 99% due to Tray operation

Power Plant Boxberg Units Q1 & Q2

Flue Gas Desulfurisation

Tray-Retrofit



Tray
Installation



Half year
service

Power Plant Boxberg Units Q1 & Q2

Flue Gas Desulfurization System

Dooble-Loop (Noell KRC Umwelttechnik GmbH)

Scope of Supply:

Optimisation of a double-loop absorber, Tray-retrofit in the upper loop, incl. design, delivery, installation and commissioning.

Flue gas flow: 1.800.000

Nm³/h

SO₂-inlet concentration: 8.400 mg/Nm³ dry

spray-levels upper loop: 4 * 7.000 m³/h

spray-levels lower loop

(Quencher): 3 * 3.600

m³/h

SO_x - removal after Tray-retrofit : > 96 %.

Location: Boxberg, Saxonia

Date of order: January 2012


Hand over: October 2012

Client: Vattenfall Europe
Generation AG

Vom-Stein-Strasse 39

D-03050 Cottbus

With the BNG Tray technology for the new plants and for retrofitting the following advantages will be achieved:

- Longer suspension residence time in the absorption zone
-  increase in SO₂ efficiency.
- Considerably improved dust and SO₃ separation in the absorber.
- Fewer / smaller circulation pumps or fewer spraying levels required (No spraying level required for the tray retrofits).
- Less power consumption for the absorber system.
- Savings in pipework, foundations and electrical / control technology.
- Less maintenance, e.g. on the pumps, due to a reduced quantity.
- Integrated maintenance platform directly beneath the spraying levels.

FGD TUROW Units 4 / 5 / 6

Latest order: Power Plant TUROW units 4, 5 and 6

Wet Flue Gas Desulfurization with the BABCOCK NOELL - Tray - Absorber System

Client: PGE Górnictwo i Energetyka Konwencjonalna S. A. – Oddział Elektrownia , Turów , Bogatynia



Fuel: local lignite and biomass
max. SO₂ - concentration: 2.500 mg/Nm³ (dry 6 % O₂)

Number of Absorber systems: 3 (1 per unit)

Sorbent: ground limestone / limestone slurry

max. flue gas amount (unit): 1.200.000 Nm³/h

max. SO₂ - removal efficiency: ≥ 97,5 %

End product: marketable gypsum

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**Thank you very much for
your attention!**