Covering the tightening emission standards in Russia with reliable customized engineering solutions and high local manufacturing content

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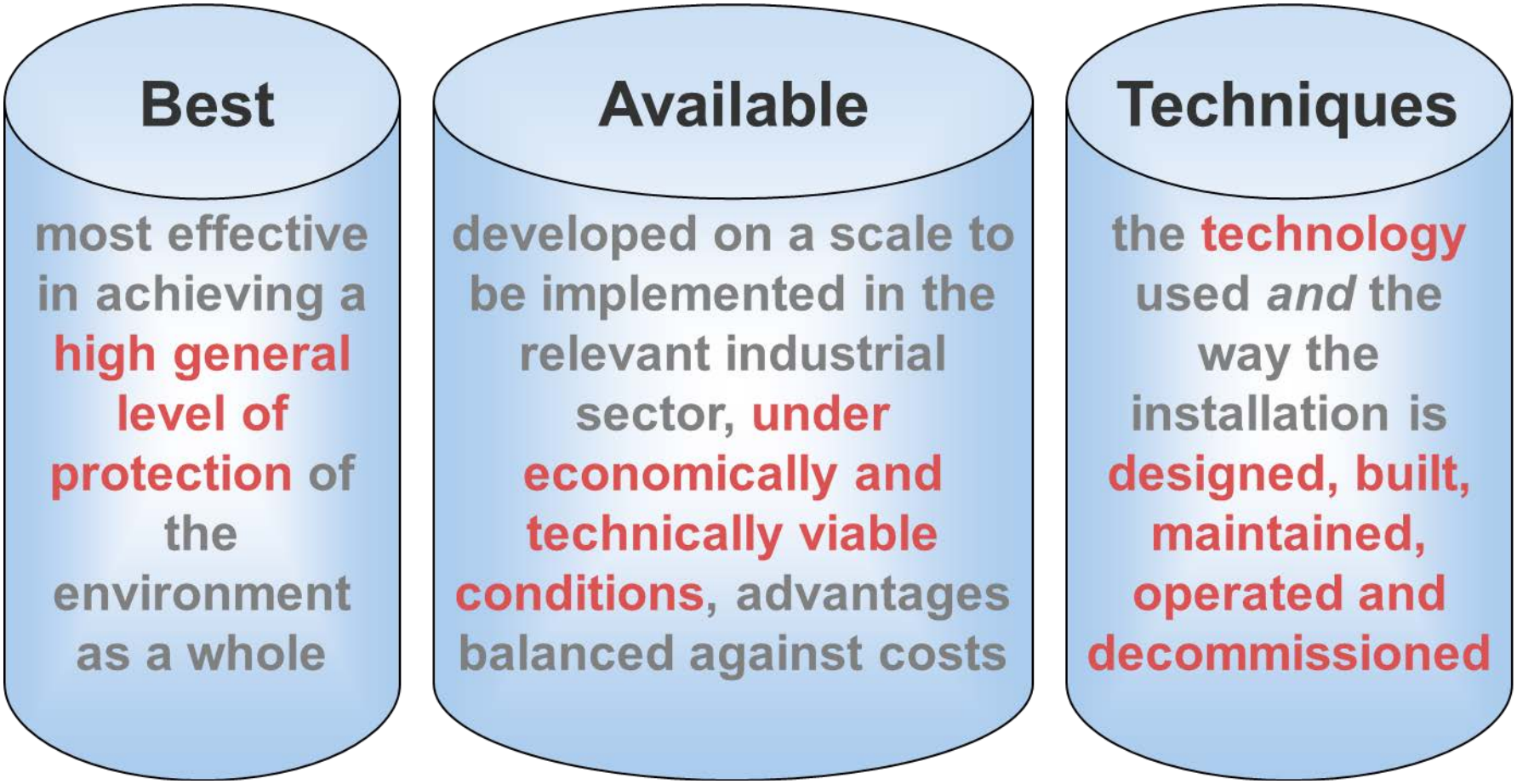
European Industrial Emissions Directive (IED) – Rationale



BAT: Best **A**vailable **T**echniques

BREF: BAT **REF**erence Document

Industrial Emissions Directive – BAT and BREF

BREF 2017: Emission Limit Values (ELVs) under discussion for existing Large Combustion Planst (LCPs) ≥ 300 MWth

	Current IED	BAT Yearly[1]	BAT Daily[1]	BREF 2017[2]	Russia
NOx [mg/Nm³]	200	65-175	85-220	150	470
PM [mg/Nm³]	20	2-10	2-10	10	150
SO_2 [mg/Nm³]	200	10-180	25-220	130	1200
HF, HCl [mg/Nm³]	---	1-5	---		
Hg [µg/Nm³]	---	1-3 (hard coal) 1-7 (lignite)	---		

1: Rolf Becks, Umweltbundesamt (German "Environmental Protection Agency"), during the 11th "VGB-Fachkonferenz REA-, SCR- und Entstaubungsanlagen in Großkraftwerken" 25./26. November 2015

2: expected new ELVs in the European Union

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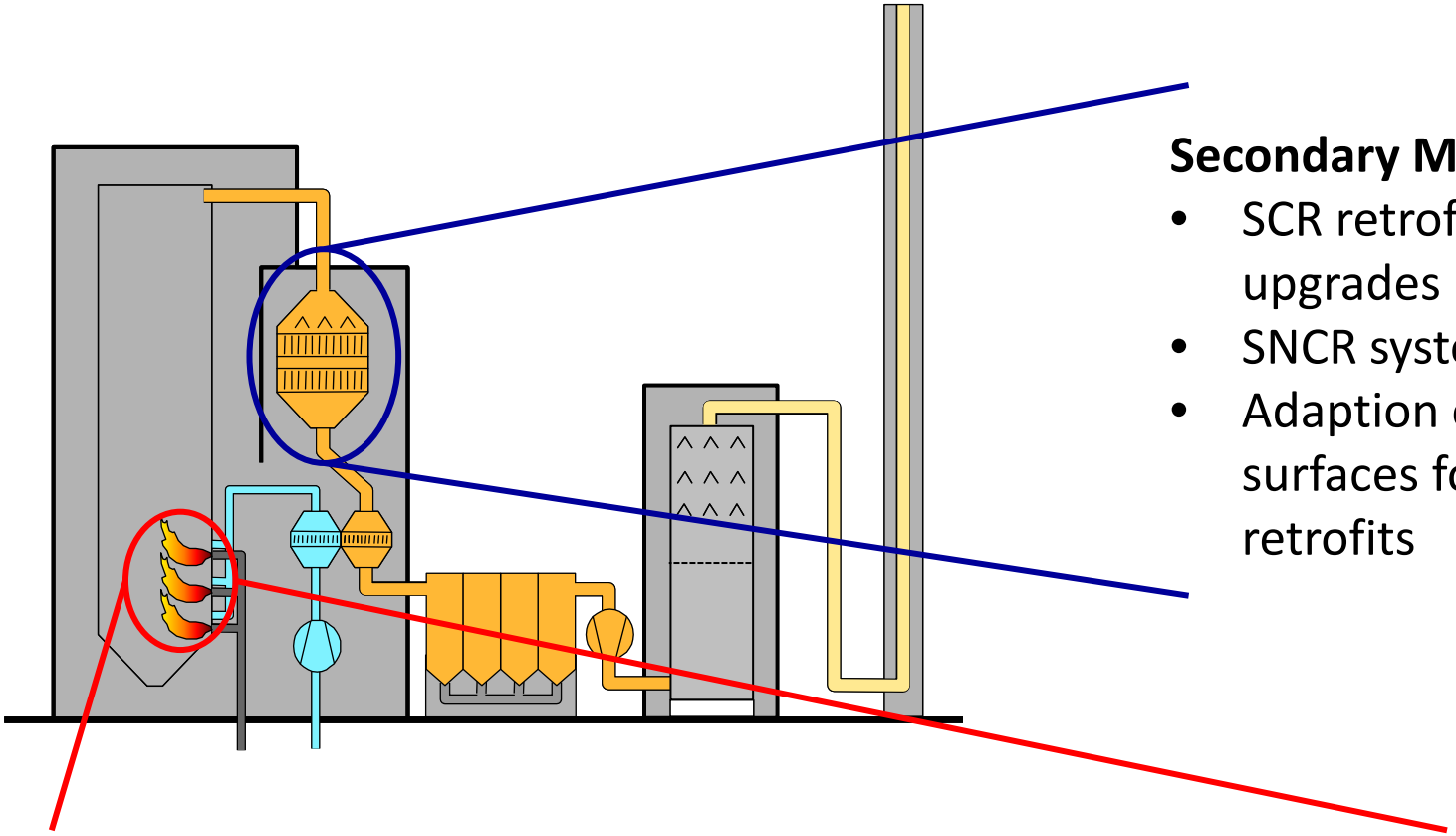
De-NOx – Steinmüller Product Range



Secondary Measures:

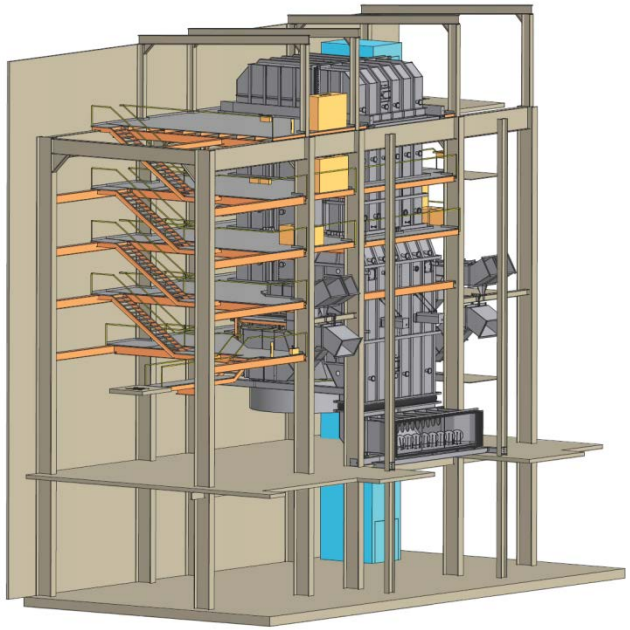
- SCR retrofits and upgrades
- SNCR systems
- Adaption of heating surfaces following SCR retrofits

Primary Measures:

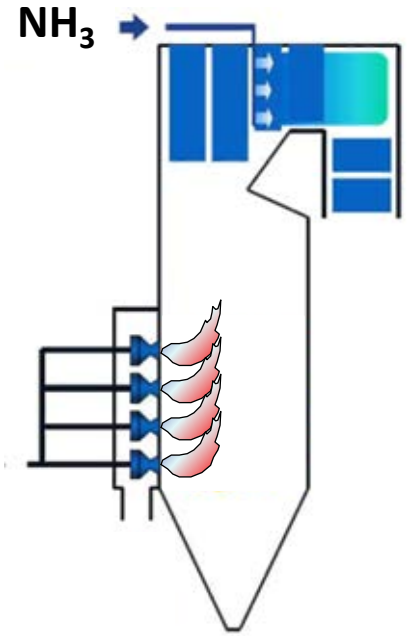
- Replacement or modifications of burners to Low-NOx-Burners
- Installation of Over-Fire-Air ports
- Optimization of air supply / air ratio
- Adaption of coal mills

De-NOx – Secondary Technologies

SCR:



SNCR:

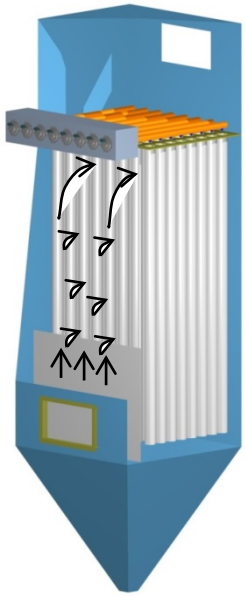


Requirement (+: positive; –: negative for owner)	**SCR**	**SNCR**
Removal efficiency	++	–
Pressure drop	–	++
CAPEX	–	+
Acceptable flue gas temperature range	–	–
Maintenance requirements	–	+

De-dusting – Technologies

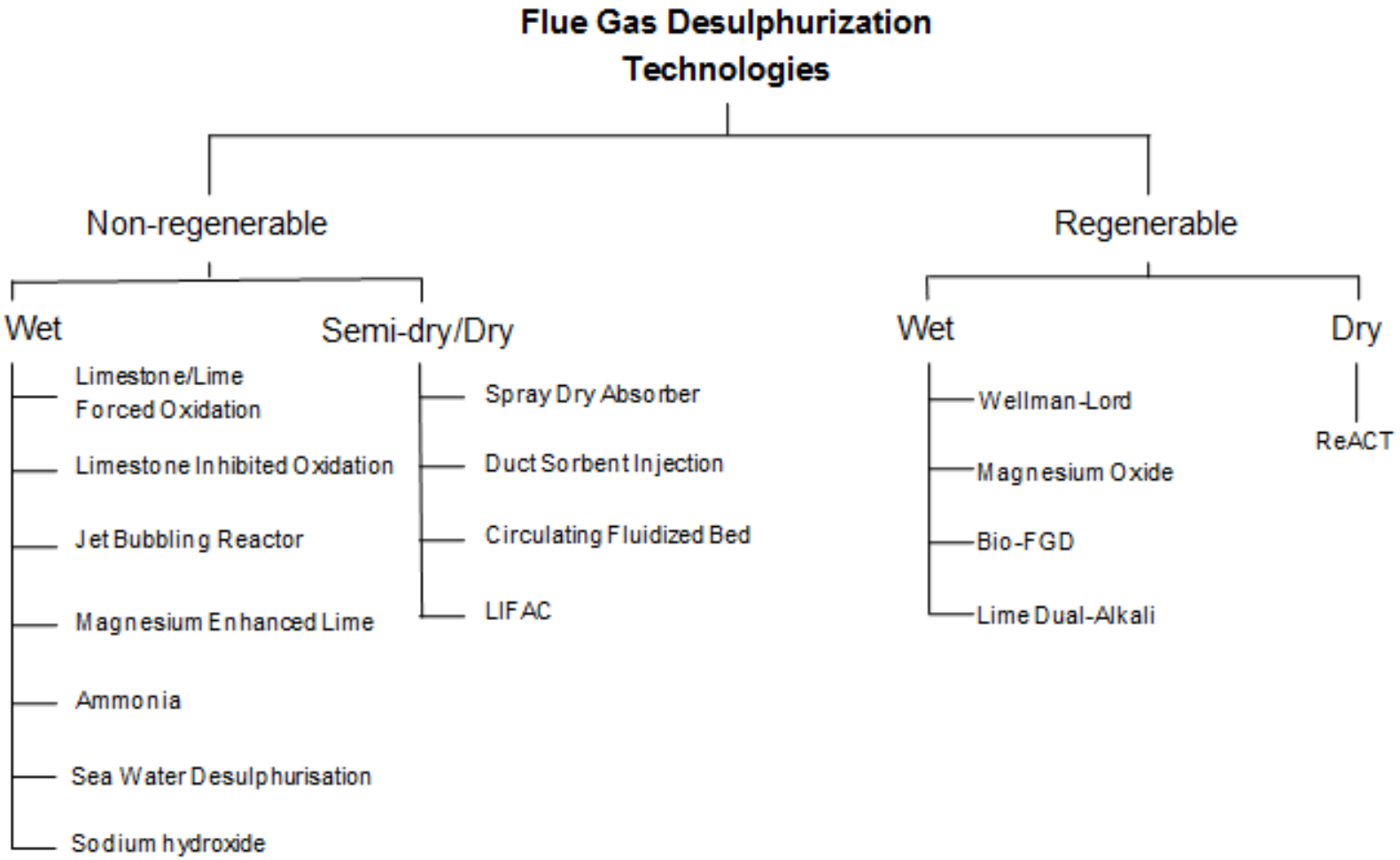
ESP:

FF:



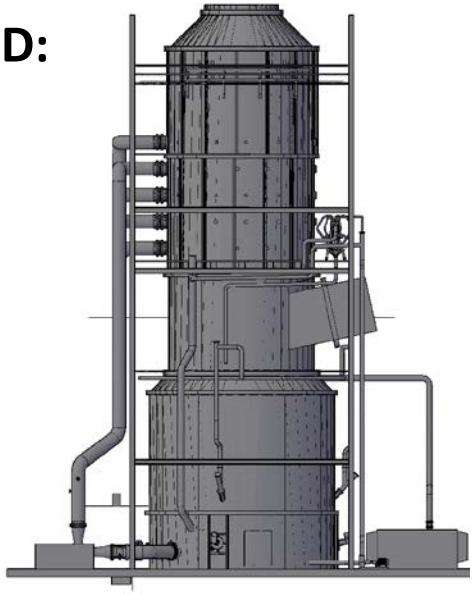
Requirement (+: positive; –: negative for owner)	**ESP**	**FF**
Removal efficiency	+	++
Acceptable dust size distribution	–	++
Pressure drop	++	–
CAPEX	– –	– –
Acceptable flue gas temperature range	+	–
Maintenance requirements	+	–

De-SOx – Technologies

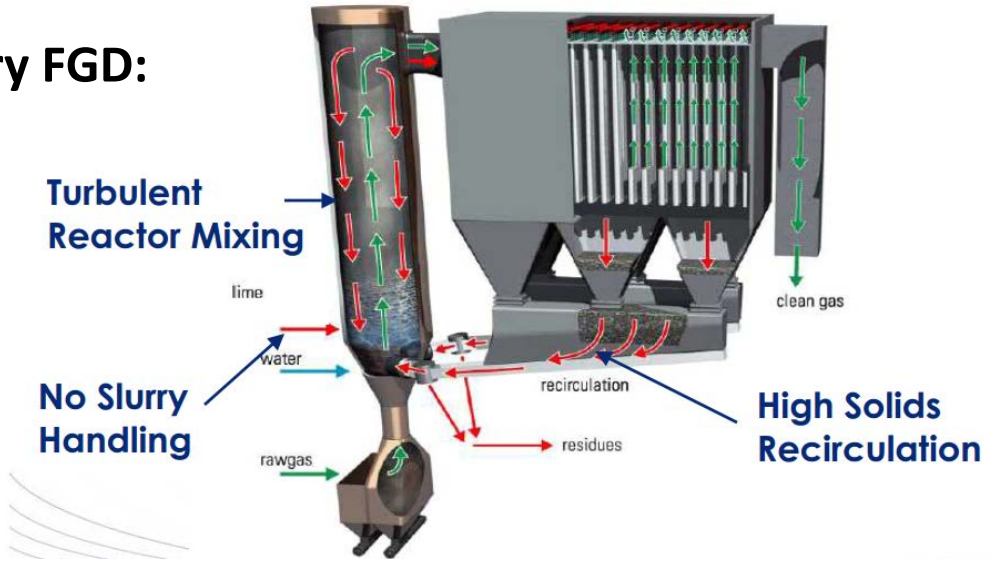


De-SOx – Technologies

Wet FGD:



Dry FGD:



Requirement (+: positive; –: negative for owner)	**Wet FGD**	**Dry FGD**
Removal efficiency	++	+
Pressure drop	–	– –
CAPEX	– –	– –
Maintenance requirements	+	–

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DeNOx – Shell Wesseling

Reference project key data

- Location Wesseling (near to Cologne) / Germany
- Refinery with fuel oil fired Boiler (unit 6)
- Boiler capacity 200 $MW_{therm.}$
- Flue gas volume flow 192.000 Nm^3_{wet}/h
- Flue gas temperature 325 °C
  (downstream of air preheater)
- NOx Emission after boiler 570 mg/Nm^3
- Firing of HFO / Cracker residue (HHVR) / off-gas

DeNOx – Shell Wesseling

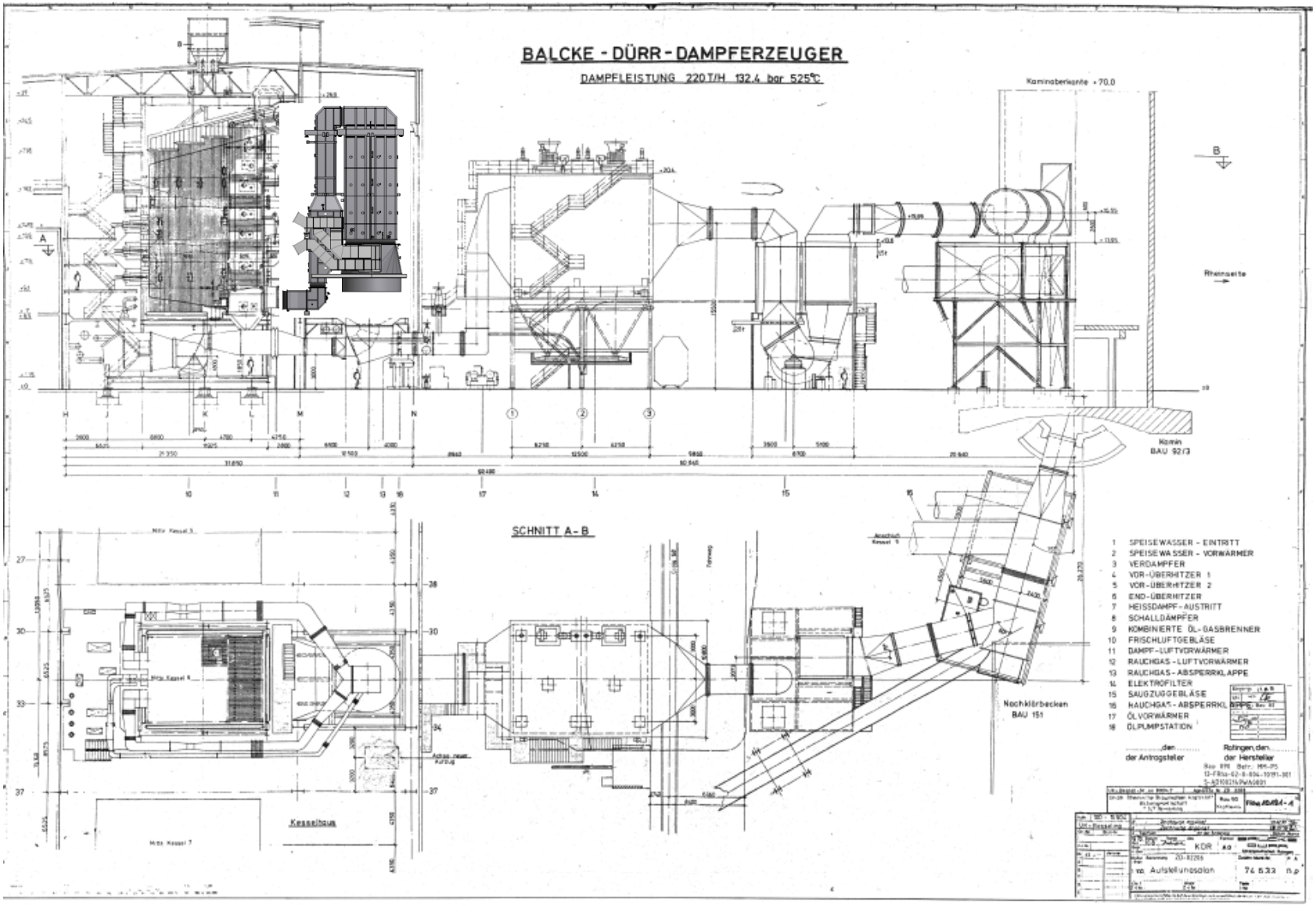
Shell Wesseling requirements:

- NOx less than 140 mg/Nm³ @ 3 % O_2,dry
- NH_3 slip less than 1 mg/Nm³ @ 3 % O_2,dry

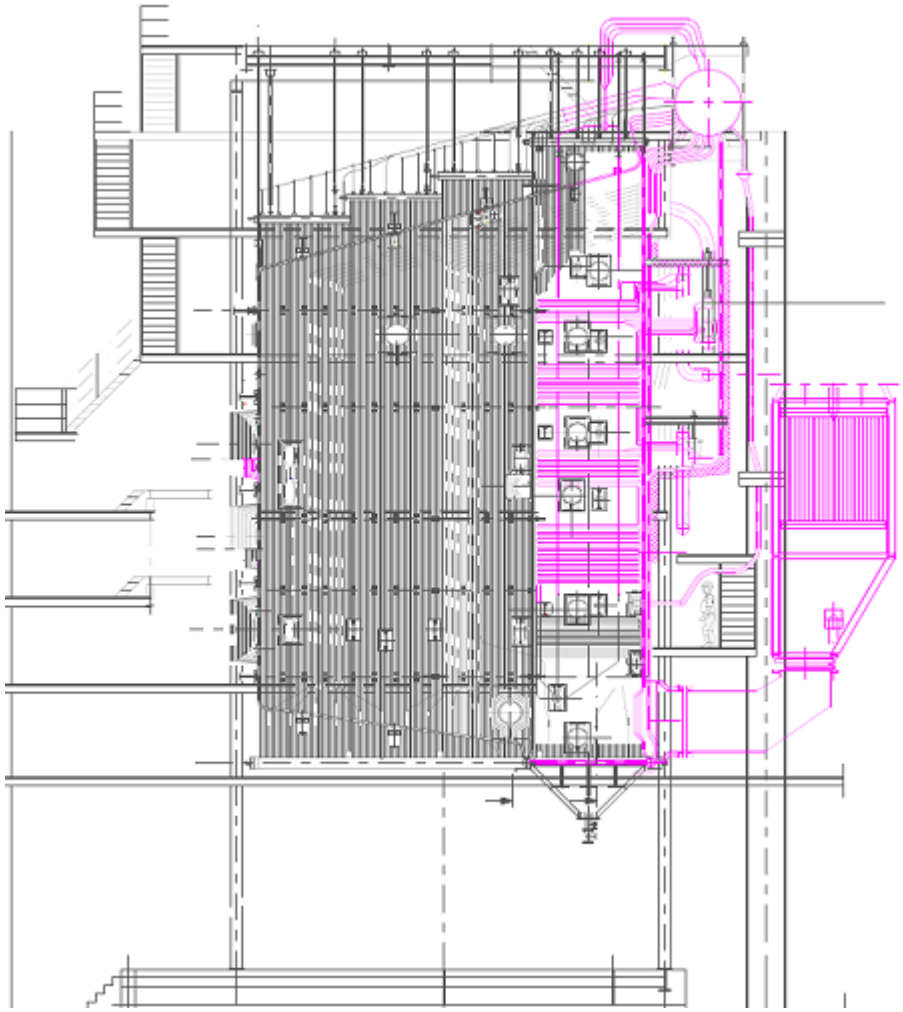
Steinmüller scope:

- Engineering and Supply of new low NOx burners
- Engineering and Supply of SCR DeNOx
  (consortium with Balcke Dürr for erection)
- Engineering of boiler heating surface modifications
  (as sub-supplier to Balcke Dürr)

DeNOx – Shell Wesseling: Implementation



DeNOx – Shell Wesseling: Modification of Pressure Part of Boiler 6



Technical Data:

Steam data	200 t/h
Max. operation pressure	132,4 bar
Test pressure (1.2 x 132.4 bar)	159 bar
Superheated steam temperature	525 °C
Year of construction	1978

Heating surfaces:

ECO I:	564 m²
ECO II:	542 m²
Natural circulation system:	1243 m²
Superheater sling tube	173 m²
Pre-Superheater 1	1187 m²
Pre-Superheater 2	522 m²
Final Superheater	249 m²
Total:	4480 m²

DeNOx – Shell Wesseling: Customer Benefits

- Integrated design (modification of heating surface and temperature window for SCR) for all load cases
- LowNOx burner design + SCR allows:
  - Cost benefit analysis of primary and secondary measures
    → Lower investment and operational costs
  - Reduction of interfaces
    → Easier contracting and handling of guarantees
- Construction and erection in existing plant with limited space
- Burners for special applications (HFO, HHVR, off-gas)

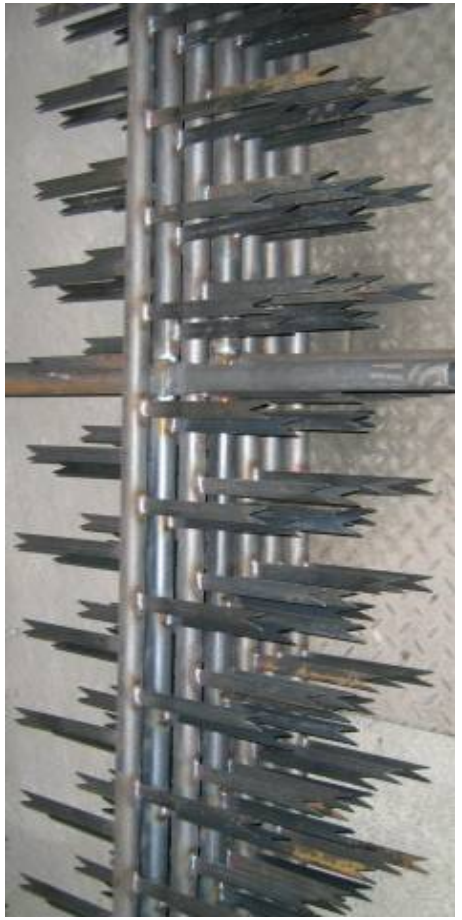
De-dusting – Example: CET Govora

- Power plant CET Govora, 7 Units of 380 MWth
  - Flue gas volume flow: 1.024.000 m³/h
  - Dust load (raw gas): 70.000 mg/Nm³ @ 6% O_2
  - Clean gas before retrofit: > 200 mg/Nm³ @ 6% O_2
  - Clean gas after retrofit: < 50 mg/Nm³ @ 6% O_2
  - Pressure loss improvement: - 30 Pa (0,3 mbar)

De-dusting – Example: CET Govora

- Target: Revamp of 2 existing ESP casings
  - Including Engineering and Supply of steel components
  - Reduce dust emission from 280 mg/Nm³ to below 50 mg/Nm³
  - Maintain original footprint
  - Reduction in pressure loss

De-dusting – Example: CET Govora - Implementation



ESPs – Customer Benefits

- Reduction of dust emissions < 10 mg/Nm³
- Upgrade possible whilst maintaining original footprint and weight (SE low weight ESP-roof)
- Reduction in pressure loss (adapted ESP lane width & ESP hoods)
- Power savings (modern high voltage aggregates & control)
- Robust design

De-SOx Example – Paroseni

Flue gas desulphurisation (FGD) system for unit no. 4
(150 MW_{el} + hot water boiler of 103,2 Gcal/h)

Client: Termoelectrica SA; Petrosani/ Romania

General Contrator: LAB CNIM; Stuttgart/ Germany

Sub-Supplier: Steinmüller Engineering ; Gummersbach/ Germany

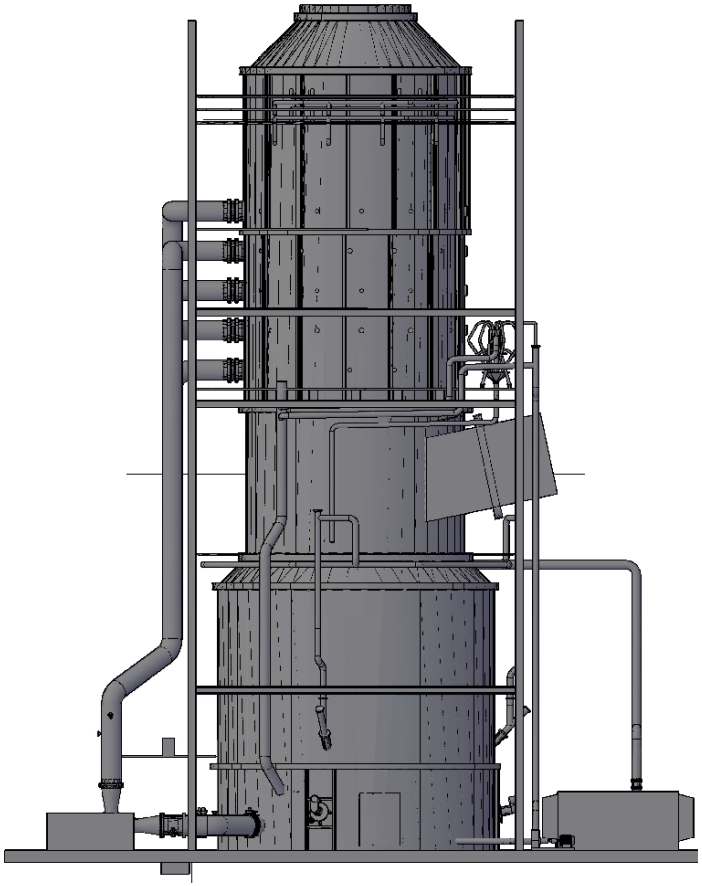
De-SOx Example – Paroseni: Flue Gas Data

607.900 Nm³/h FG

7.400 mg/Nm³ SO_2

100 mg/Nm³ Particles

8.046 kg/h Limestone



615.600 Nm³/h FG

400 mg/Nm³ SO_2

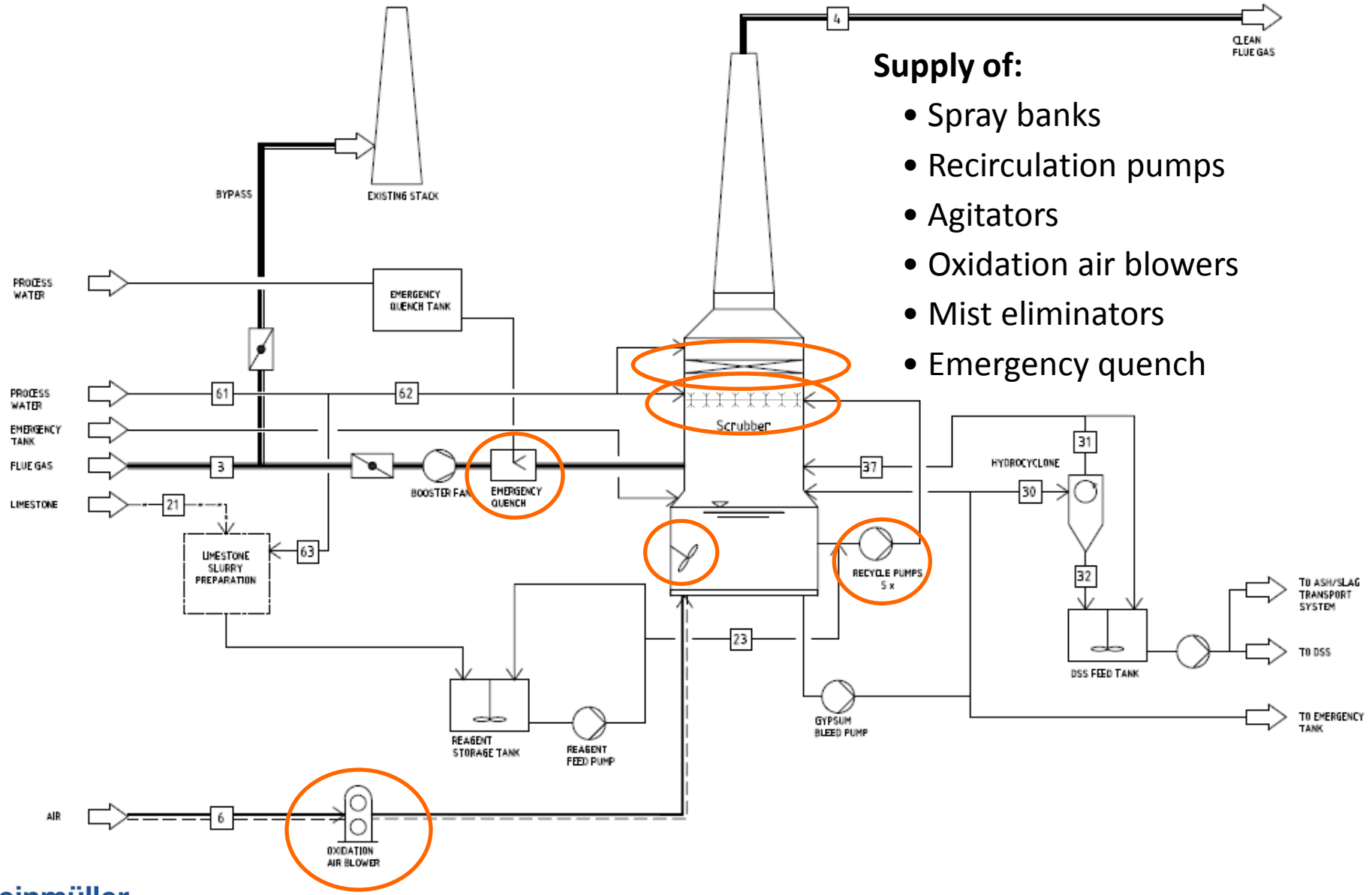
50 mg/Nm³ Particles

13.183 kg/h Gypsum

De-SOx Example – Paroseni: Scope Split

scope:	LAB	SE
Project lead	X	
Process design		X
Basic design	o	o
Detail design	X	
Technical specification		X
Sub supplier evaluation		X
Purchase of main component		X
Detail engineering	o	o
Construction	o	o
Commissioning	o	o

De-SOx Example – Paroseni: Key components



Supply of:

- Spray banks
- Recirculation pumps
- Agitators
- Oxidation air blowers
- Mist eliminators
- Emergency quench

Content

Typical contract structure for APC retrofits

scope:	LAB	SE
Project lead	X	
Process design		X
Basic design	o	o
Detail design	X	
Technical specification		X
Sub supplier evaluation		X
Purchase of main component		X
Detail engineering	o	o
Construction	o	o
Commissioning	o	o

Content

Introduction – Emission Limit Values around the Globe

Air Pollution Control Technologies

Reference Projects

Contract Structures

Summary

Summary

Our Solutions for Air Pollution Control Upgrades

- Meeting of emission limit requirements in answer to Legislation
- Delivery of key components (guarantees!)
- Balancing (CAPEX & OPEX) between primary and secondary APC upgrades
- Integrated plant solutions
- High level of scope localization
  - Quality Inspection Protocols, Manufacturing supervision
  - Supervision of Erection & Commissioning
- Know-How transfer

We will find the best solution for your plant together !

Thank you for your attention