



Advanced Flue Gas Cleaning and mercury removal technologies of ANDRITZ AG

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The ANDRITZ GROUP

Overview

ANDRITZ is a globally leading supplier of plants, equipment, and services for hydropower stations, the pulp and paper industry, the power industry, the metal-working and steel industries, and solid/liquid separation in the municipal and industrial sectors

Headquarters: Graz, Austria

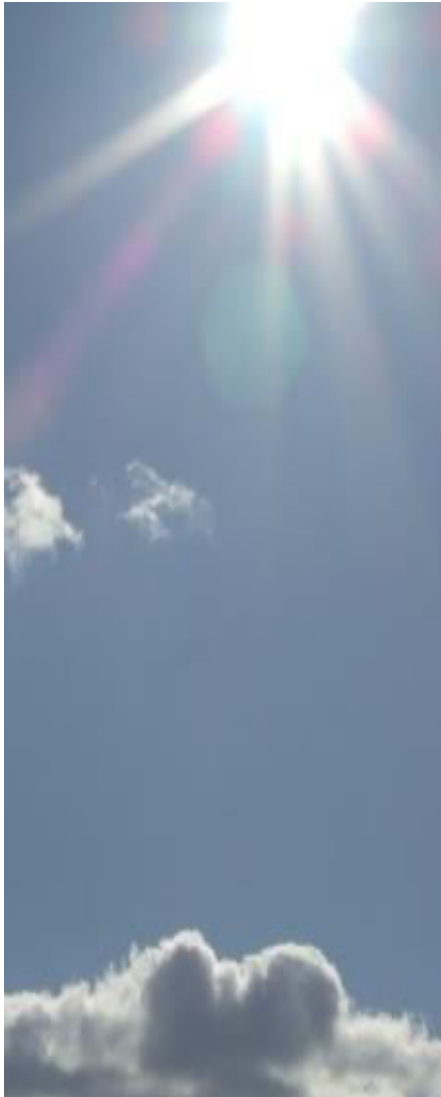
Global presence: over 250 production sites and service/sales companies worldwide

KEY FINANCIAL FIGURES 2015

	Unit*	2015
Order intake	MEUR	6,017.7
Order backlog (as of end of period)	MEUR	7,324.2
Sales	MEUR	6,377.2
EBITA	MEUR	429.0
Net income (including non-controlling interests)	MEUR	270.4
Employees (as of end of period; without apprentices)	-	24,508



ANDRITZ Air Pollution Control



Innovative environmental engineering

- Leading APC company with wide range of technologies
- Over 200 references worldwide with our wet FGD technology (> 120.000 MWeI)
- Over 100 references for our SCR technology
- Over 50 references with our semi dry Turbo CDS technology
- More than 30 years of experience and competence
- Product portfolio varies from service provider up to general contractor for turnkey flue gas cleaning plants

Emission Requirements in India

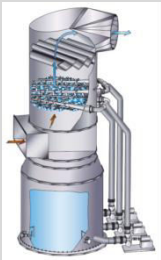
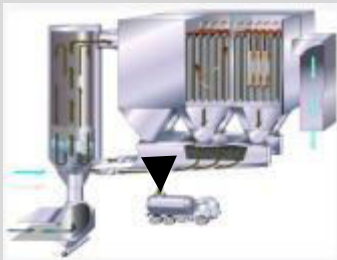

for removal of SO_x, dust, Hg, heavy metals, NO_x, etc.

Plants installed before 31 st December, 2003		
SPM	100mg/Nm ³	
SO ₂	600 mg/Nm ³	Capacity <500 MW
	200 mg/Nm ³	Capacity ≥ 500
NO _x	600mg/Nm ³	
mercury	0.03mg/Mn ³	Capacity ≥ 500
Plants installed from 1 st Jan 2004 to 31 st Dec., 2016		
SPM	50mg/Nm ³	
SO ₂	600 mg/Nm ³	Capacity <500 MW
	200 mg/Nm ³	Capacity ≥ 500
NO _x	300mg/Nm ³	
mercury	0.03mg/Nm ³	Capacity ≥ 500
Plants installed after 1 st January, 2017		
SPM	30mg/Nm ³	
SO ₂	100 mg/Nm ³	
NO _x	100mg/Nm ³	
mercury	0.03mg/Mn ³	

- Indian Coal: moderate SO₂ conc. of 1000 to 2500 mg/m³(std.;dry; 6%O₂) from coal with up 0,6% S; high ash conc. (up to 45%)
- FGD technologies like Wet Limestone FGD, Seawater FGD or semi dry FGDs (CDS)
- SPM: emission limit could be challenging depending on dust inlet at FGD → FGDplus improves dust removal
- Main issue for SCR DENOX is high ash concentration
- Mercury emission mostly will not exceeded limit; low Hg content in coal; 0,1 – 0,4 mg/kg Hg ~ 13 – 50 mg/m³ (std., dry)

Complete product range of Air Pollution Control

for removal of SO_x, dust, Hg, heavy metals, NO_x, etc.

	Wet method	Dry method	DeNO _x
Type			
Power stations	<p>Wet Limestone FGD</p> <ul style="list-style-type: none"> FGDplus <p>Mercury Removal</p> <ul style="list-style-type: none"> Seawater FGD CO₂ absorption 	<ul style="list-style-type: none"> Dry sorption Turbo-CDS / TurboSorp Mercury removal Dust removal 	<ul style="list-style-type: none"> SCR (high-dust application) SCR for combined cycle power plants (CCPP)
Industry incl. EfW and biomass	<ul style="list-style-type: none"> Wet FGC (calcium and NaOH based) Multistage scrubber Combined systems 	<ul style="list-style-type: none"> Dry sorption TurboSorp 	<ul style="list-style-type: none"> SCR (low-dust / clean gas application)

Wet limestone flue gas desulphurization by ANDRITZ



Wet limestone flue gas desulphurization (FGD)

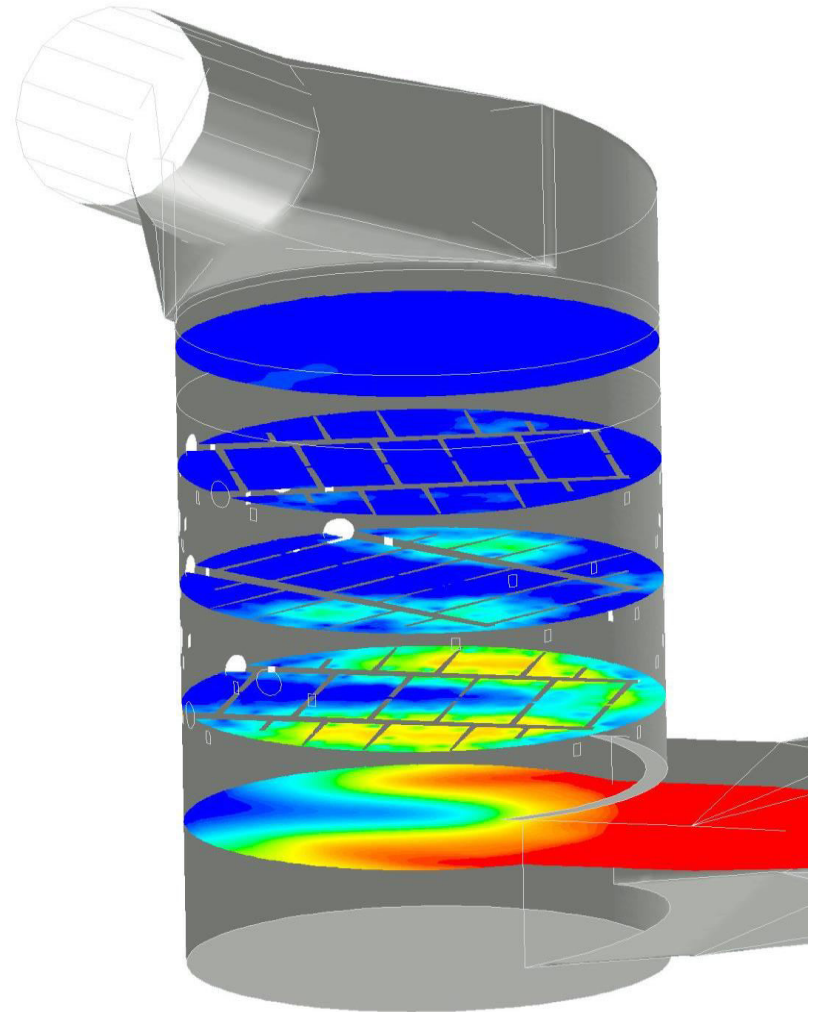
Technology - Overview

Process characteristics / Advantages

- Open spray tower optimized by advanced CFD tools
- Using **CFD Modelling** for optimizing the absorption
- FGDplus to improve SO₂ and dust removal efficiency and realize lowest emission level
- Removing of acid gaseous pollutants (SO₂, HCl, HF)
- Limestone as available and cheap absorbent
- Producing marketable gypsum for cement industry or wallboard
- Reaching SO₂ removal > 99%
- Most used technology worldwide

Our Experience:

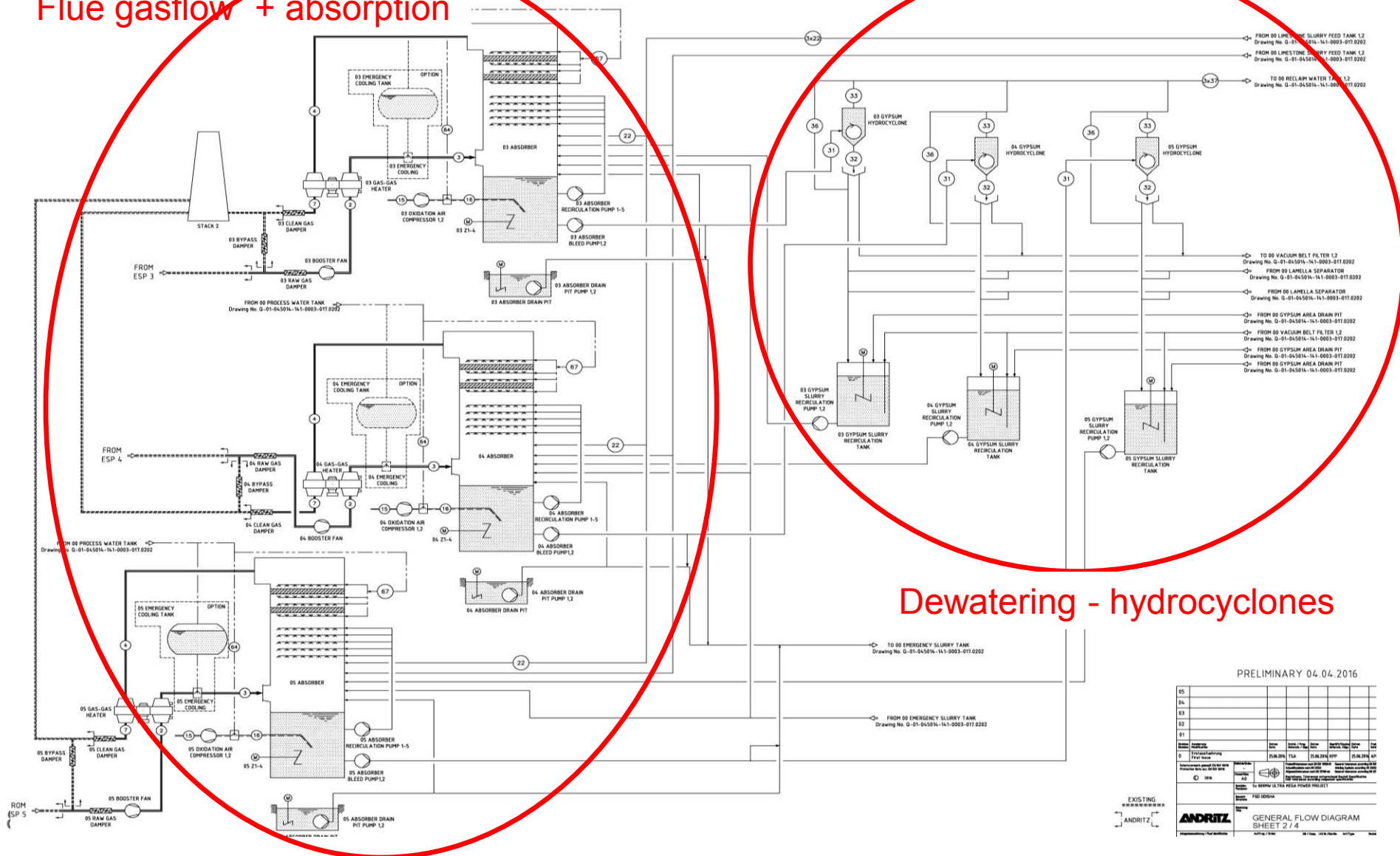
- Flue gas volume up to 4.8 Mio. m³/h (std,wet)
- SO₂ (references) up to 15,000 mg/m³ (std,dry)
- SO₂ (test plant) up to 30,000 mg/m³ (std,dry)
- SO₂ (clean gas) 50 - 200 mg/m³ (std,dry)



Wet FGD – Process Flow Diagram – Turn Key Plant

Flue Gas System - Absorber – 1st stage of dewatering

Flue gasflow + absorption



Dewatering - hydrocyclones

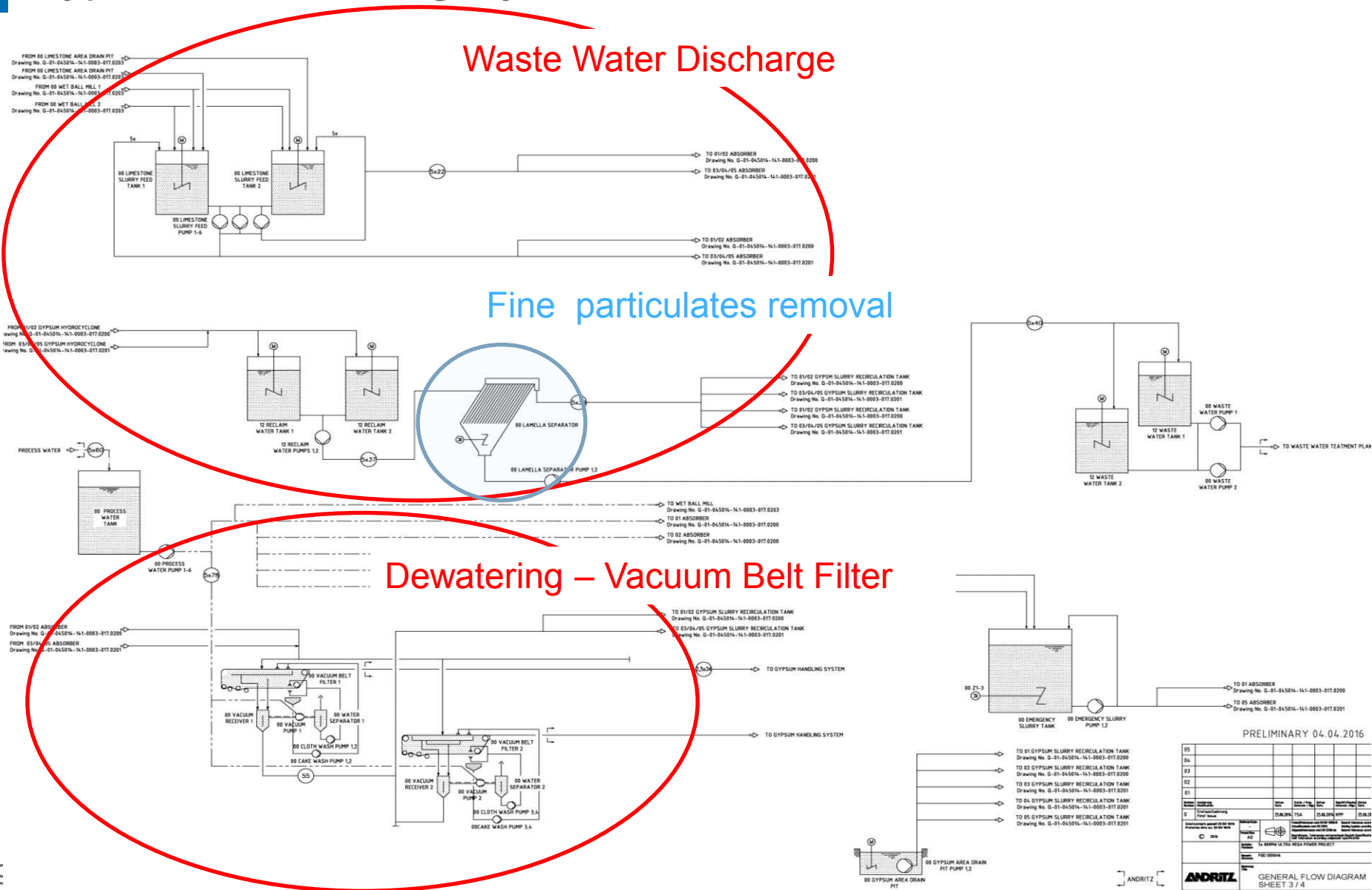
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NO.	DESCRIPTION	DATE	BY	CHKD.	APPD.
01	DESIGN				
02	CONSTRUCTION				
03	OPERATION				
04	MAINTENANCE				
05	REPAIR				
06	REPLACE				
07	REBUILD				
08	REWORK				
09	REUSE				
10	RECYCLE				
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100	RECYCLE				

GENERAL FLOW DIAGRAM
SHEET 2 / 4

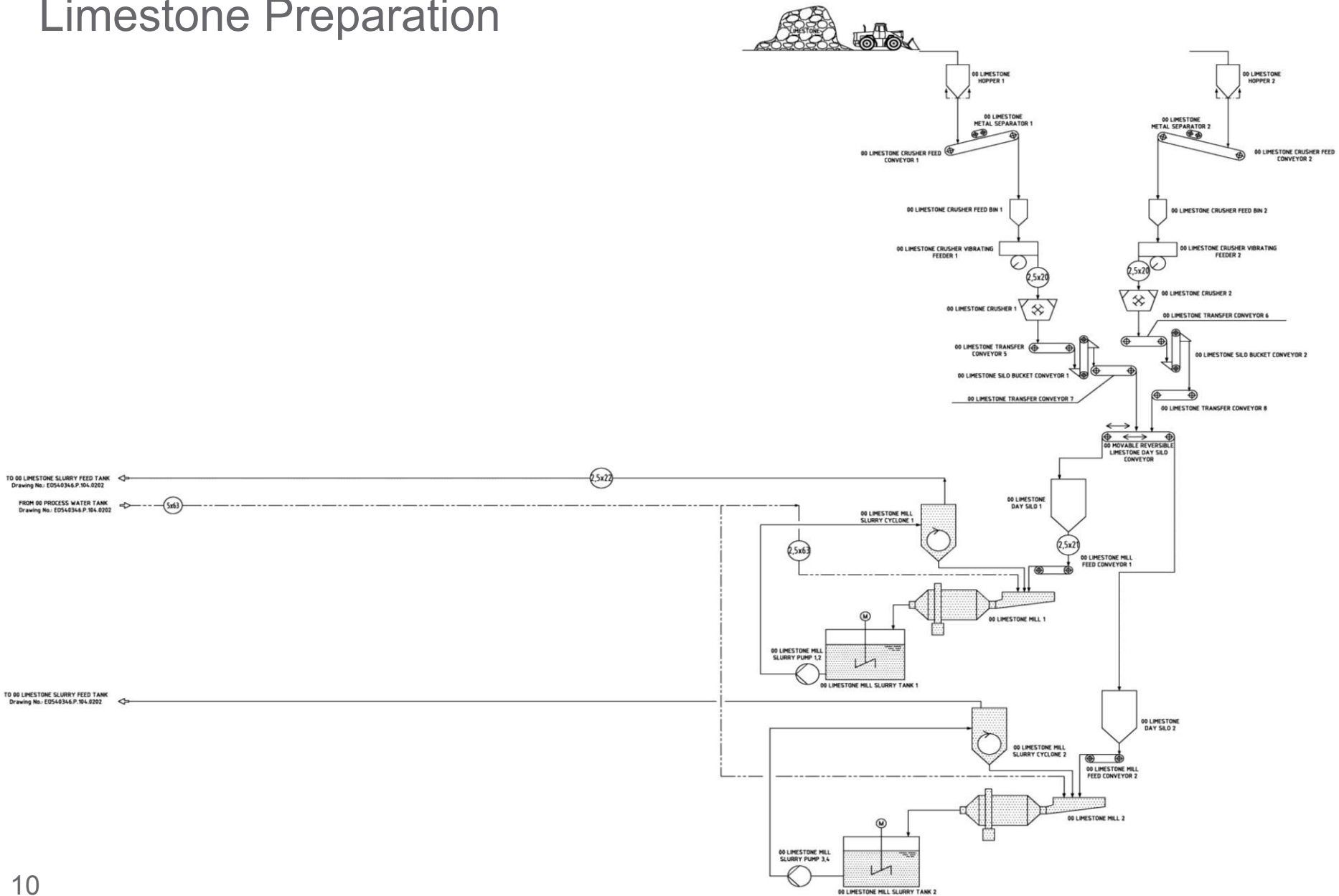
Wet FGD – Process Flow Diagram – Turn Key Plant

Gypsum Dewatering System



Wet FGD – Process Flow Diagram – Turn Key Plant

Limestone Preparation



Optimizing Absorber STEP 2 - FGDplus

Example FGD Niederaußem unit G – 660 MWe



Optimizing Absorber STEP 2 - FGDplus

Upgrade of existing absorber and new installations

Process characteristics / Advantages

- Scrubber with adapted mass-transfer regime in order to increase SO₂ removal
- Optimized combination of high removal and fine removal within the absorption zone
- Maximize dust, aerosol and HM removal
- Decrease of invest costs
 - Number of spray banks
 - Absorber height (sump, absorption zone)
 - Pump size
- Decrease of operation costs
 - Pressure at nozzles for direct feeding
 - Decrease of liquid to gas ratio

Capacity:

- Flue gas volume up to 4.8 Mio. m³/h (std,wet)
- SO₂ concentration up to 30,000 mg/m³ (std,dry)

