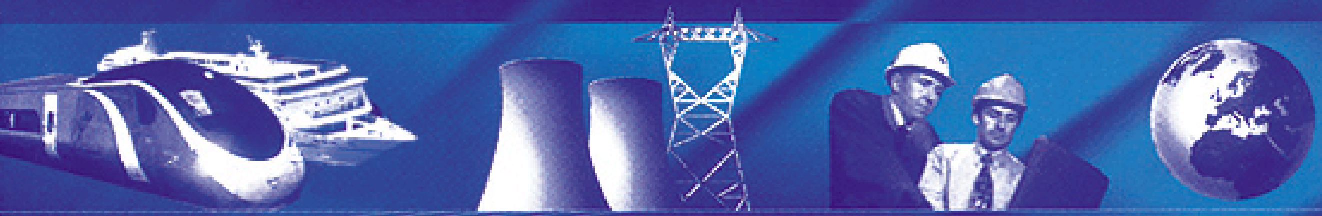


2003

ALSTOM Flue Gas Desulfurization Technologies

ALSTOM

Agenda

- ALSTOM
  Environmental Control Systems
- FGD Technologies
  - Wet Flue Gas Desulfurization
  - Dry Flue Gas Desulfurization
  - Seawater Flue Gas Desulfurization
- Summary

ALSTOM Today

ALSTOM

Transport

Energy

The global specialist in energy and transport infrastructure.

Power

Sales:
10.9 billion euros

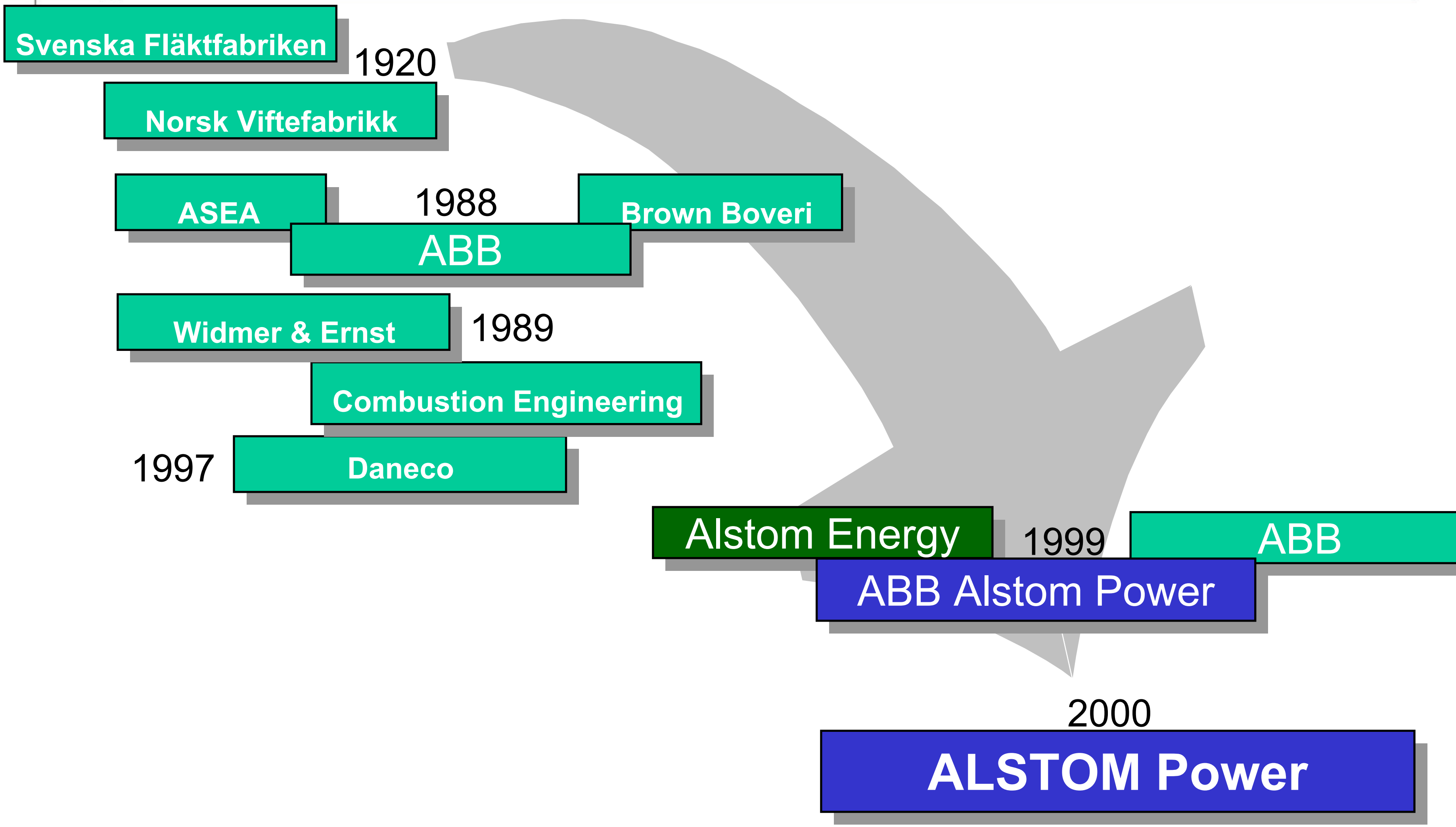
Orders received:
8.4 billion euros

Reorganized into three sectors:

- Power Service
  - No. 1 in service
  - Largest installed base of equipment
- Power Turbo Systems
  - No 1 to No. 3 in steam turbines, generators and power plant engineering construction
- Power Environment
  - No. 1 in boilers, environmental and hydro
  - New regulations driving market growth

The Full Service Provider in Power Generation

In the rear mirror



1000 people worldwide with a 600 MEUR business

Process Technologies

- Particulate Removal
  - Electrostatic precipitators (wet and dry) & SO3 conditioning
  - Fabric Filters

- Gaseous Emissions, FGD
  - Limestone (wet), lime (wet/dry) and seawater desulfurization

- Post Combustion DeNOx
  - Selective Catalytic Reduction (boilers)
  - SCONOx (GT)
  - Hug™ urea to ammonia systems

- Knowledge Based IT Solutions
  - Pegasus neural network applications
- Integrated Emission / Heat Recovery
  - ETS for petrochemical

Our Complete Solutions

- Green field, retrofit, upgrade installations
- Full range of environmental systems, products, components & services
- Turnkey project management and Engineering from initial concept to handover
- Post-installation maintenance & assistance
- More than 30 years of global references in Power plants and industrial applications

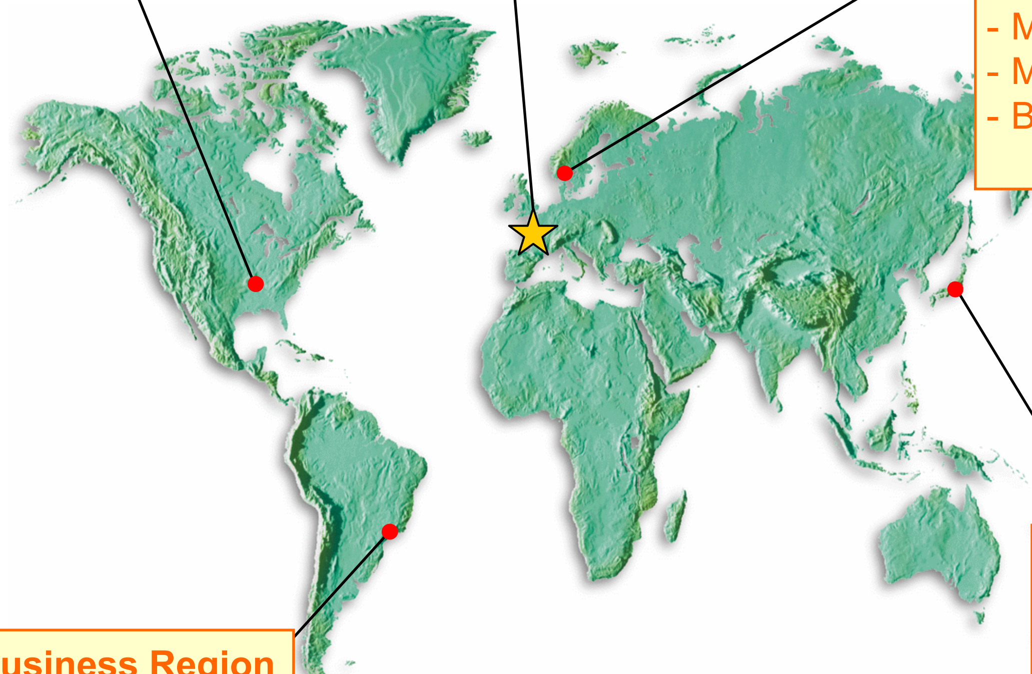
Who We Are

ALSTOM

Headquarters
Velizy, France

North America Business Region
Knoxville, TN USA (344)

Europe, Middle East & Africa Business Region
Oslo, Norway (126)
- Helsinki, Finland (54)
- Vaxjo, Sweden (146)
- Milan (43) and Udine (40), Italy
- Moscow, Russia (14)
- Butzbach, Germany (41)



Latin America Business Region
Sao Paulo, Brazil (20)

Asia Pacific Business Region
Kobe, Japan (72)
- Calcutta, India (103)
- Sydney, Australia (31)
- Beijing/Shanghaii, China

GLOBAL Experience LOCAL Solutions ENVIRONMENTAL Compliance

FGD Experience

ALSTOM

Personnel

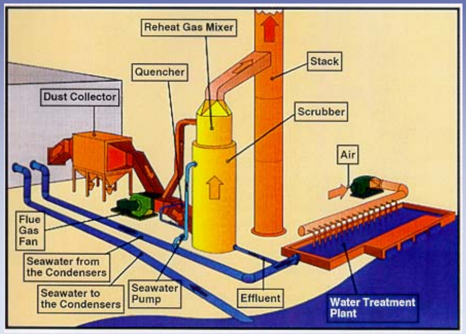
- International FGD Offices
  - Oslo, Norway
  - Vaxjo, Sweden
  - Milan, Italy
  - Sydney, Australia
  - Kobe, Japan
  - Knoxville, USA
- Over 1500 man-years of FGD knowledge and experience in USA office alone
- Multi-Discipline International Engineering Capabilities
- Global Equipment Sourcing

ALSTOM Flue Gas Desulfurization Technologies

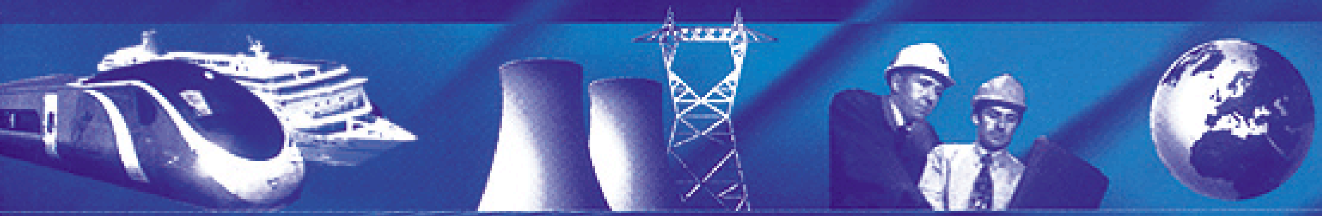
Wet Flue Gas Desulfurization

Dry Flue Gas Desulfurization Spray Dryer Absorber

Seawater Flue Gas Desulfurization



Dry Flue Gas Desulfurization NID

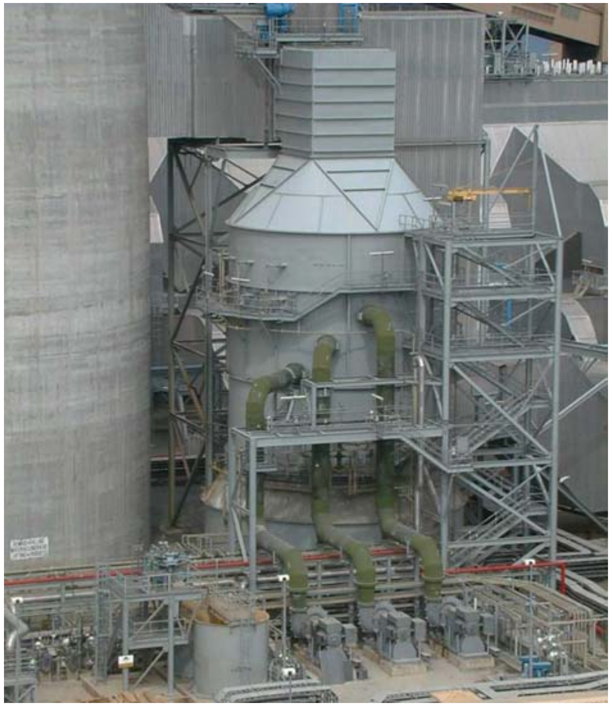


Wet Flue Gas Desulfurization Systems

ALSTOM

Wet FGD Experience

- SO_2 Removal Efficiencies Greater than 98%
- Availability Greater than 98%
- Experience with Low to High Sulfur Fuels (4.5% S; >5,000 ppm SO_2)
- Commercial Grade Byproducts
  such as Gypsum or Byproducts for Landfill
- Low Cost/Optimal Design
- New and Retrofit Projects



Sual Units 1 & 2 Generating Station
Sual, Philippines

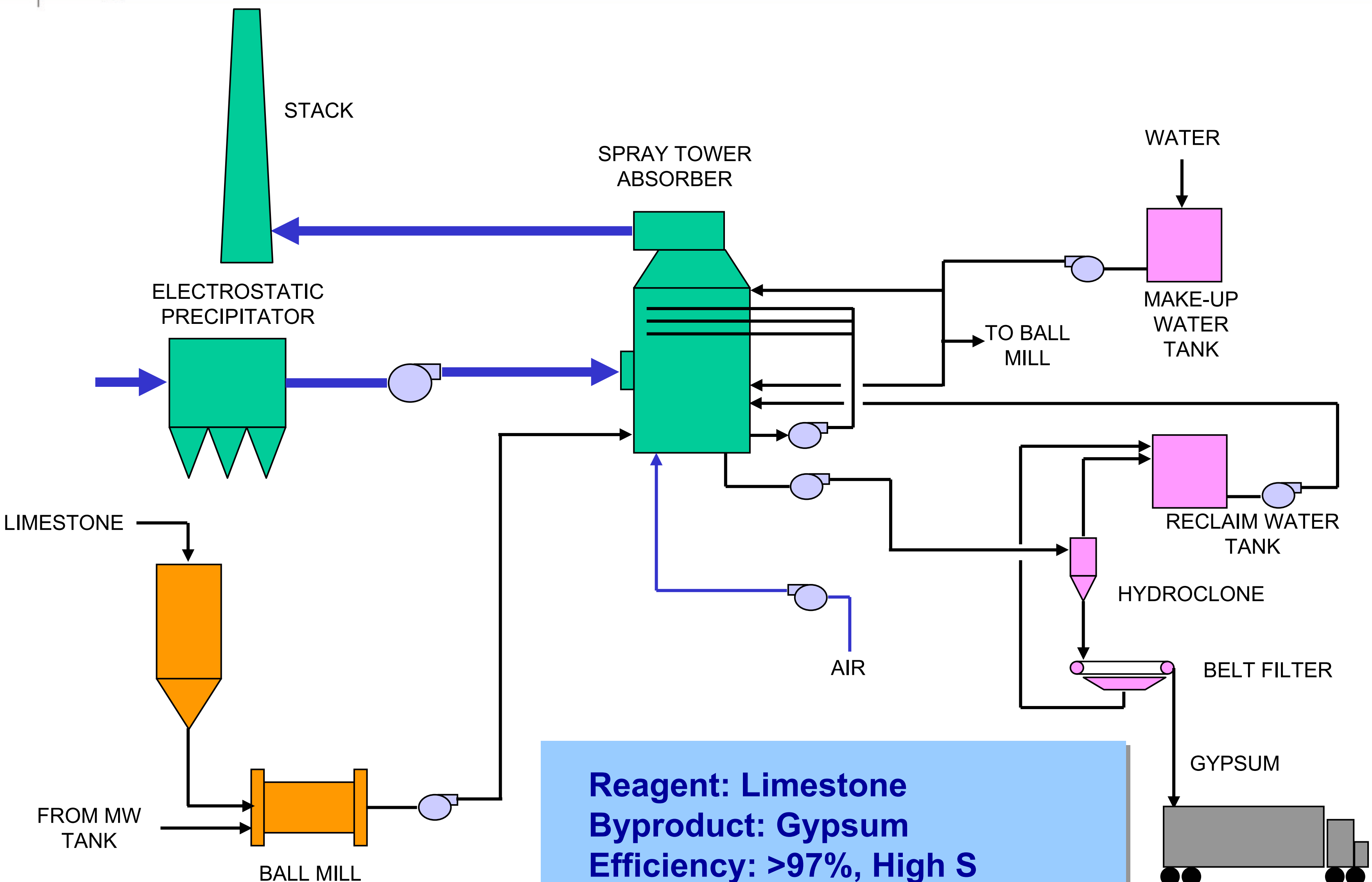
Recent WFGD References

Customer	Plant	MW	%S	Start-Up	Country
San Antonio CPSB	J.K. Spruce 1	546	0.6	1992	US
Isefjordverket	Asnaes 5	650	2.5	1993	DK
Taiwan Power Co.	Lin Kou 1&2	2x350	2.0	1994	TW
Tennessee Valley Authority	Cumberland 1&2	2x1300	4.0	1994	US
Virginia Power	Clover 1&2	2x440	1.7	1994/95	US
GPU-GENCO	Conemaugh 1&2	2x936	2.8	1995	US
Ohio Edison Company	Niles	133	3.5	1995	US
ZEPAK	Konin 7&8	110	1.0	1997	PL
Salt River Project	Navajo 1,2,3	3x803	0.6	1997-99	US
Mirant	Sual 1&2	2x609	1.0	1998	PH
Energotrans	Melnik I	6x55	2.0	1997	CZ
ENDESA	Compostilla II	330	1.8	1997	ES
KKAB	Karlshamn	340	3.5	1997	SE
EGAT	Mae Moh 4-7	4x150	2.4	1999	TH
Community of Randers	Randers	2x40	2.0	1999	DK
TransAlta/PacifiCorp	Centralia 1 & 2	2x730	1.0	2001-02	US
Edison Mission Energy	Homer City	692	3.7	2001	US
PPC (Greek Power Authority)	Florina	330	3.0	2003	GR

32,900 MW Total Installed/Under Contract

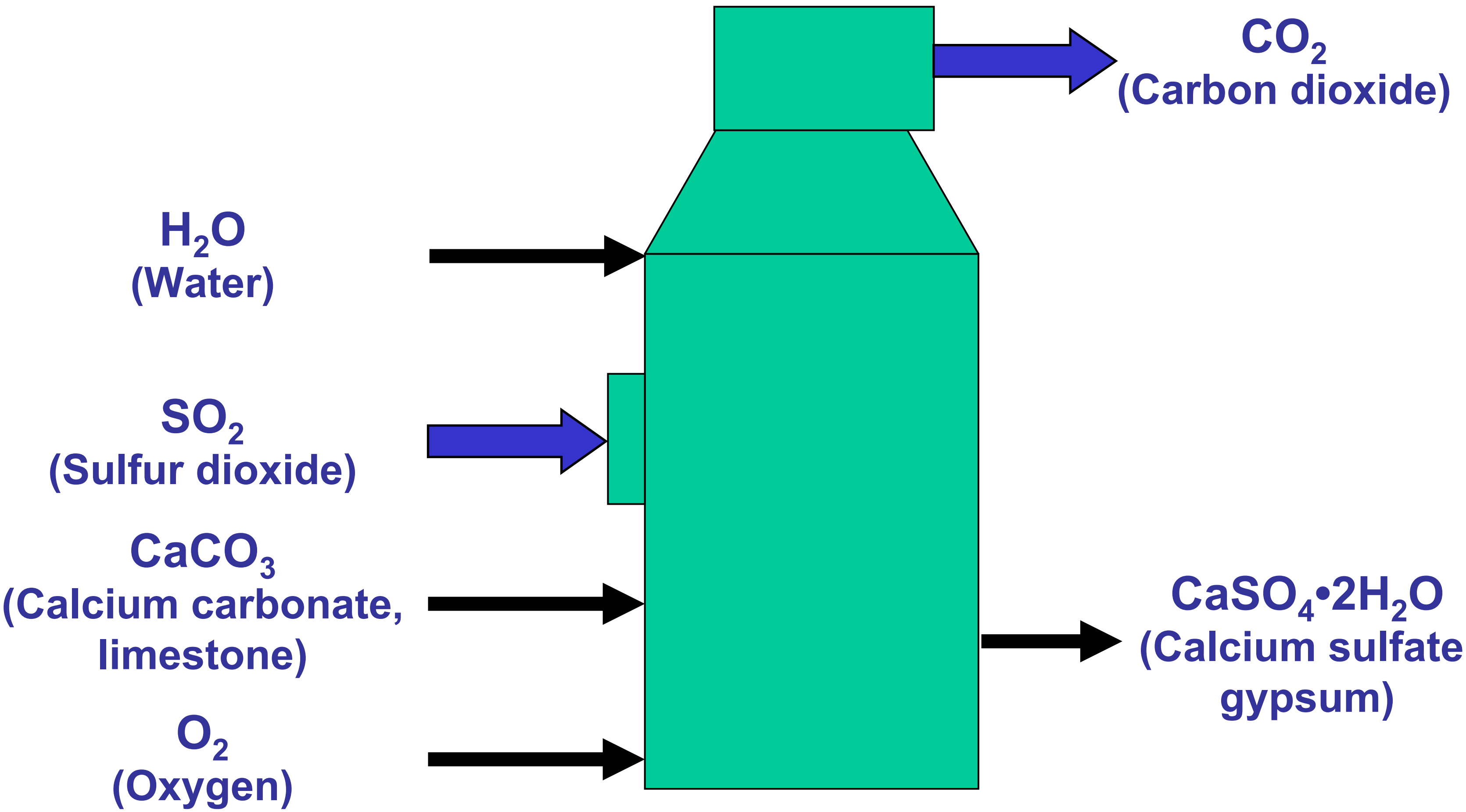
WFGD Process Flow Diagram

ALSTOM



Reagent: Limestone
Byproduct: Gypsum
Efficiency: >97%, High S

Limestone/Forced Oxidation

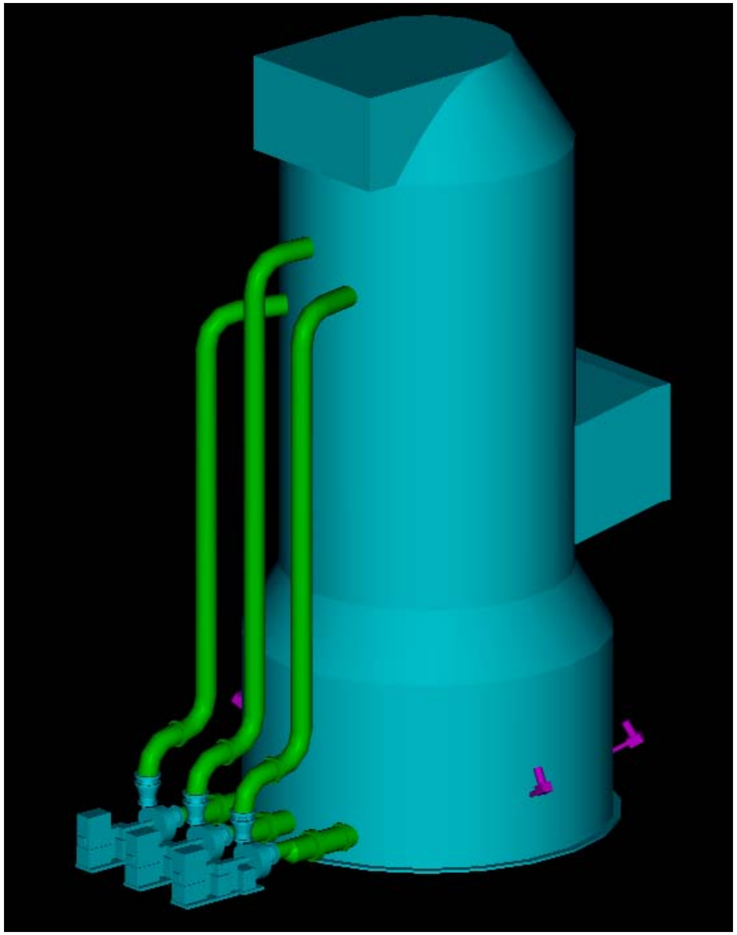


$$SO_2 + CaCO_3 + \tfrac{1}{2}O_2 + H_2O \rightarrow CaSO_4 \cdot 2H_2O + CO_2$$

Open Spray Absorber

ALSTOM

- Countercurrent flue gas / scrubbing liquor
- Size/cost increases with:
  - Gas flow
  - Sulfur inlet loading
  - Removal efficiency
- Materials of construction:
  - Flake-lined steel
  - Rubber-lined steel
  - Stainless steel
  - Nickel-based alloys
  - FRP
  - Tile Lined

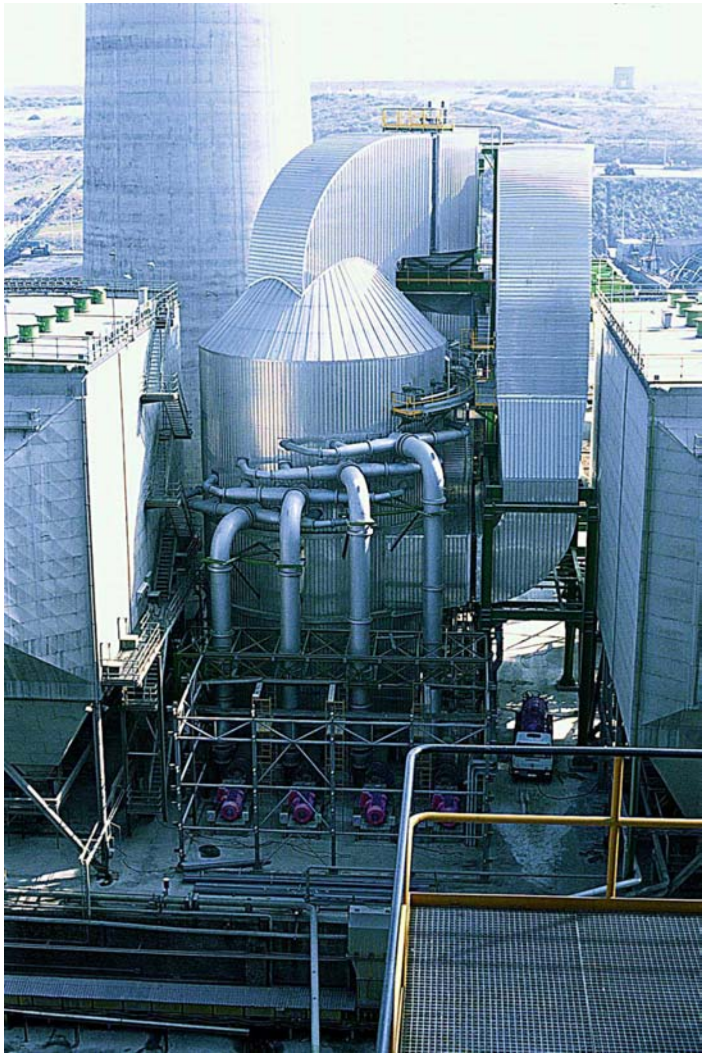


WFGD Design Basis

ALSTOM

Absorber Design

- Liquid to Gas Ratio (L/G)
  - Inlet SO_2 Concentration
  - SO_2 Removal Requirement
  - Scrubbing Liquor pH
  - Spray Zone Height
  - Spray Nozzle Characteristics
  - Chlorides (HCl gas)
  - PEP
  - Absorber Gas Velocity
  - Similar Plant Experience
- Reaction Tank
  - Limestone dissolution, gypsum formation
  - Liquid Residence Time
  - Solids Residence Time



Absorber Spray Zone

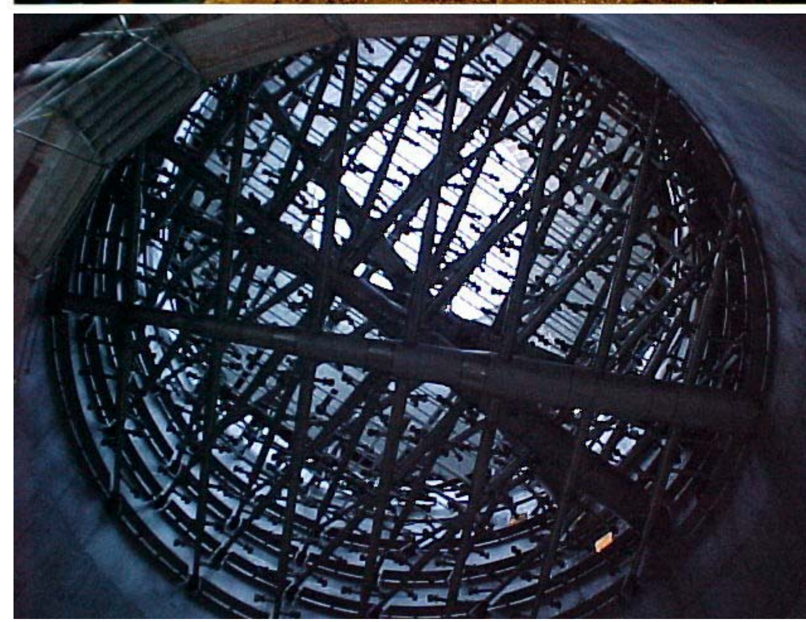
Spray Headers

- Countercurrent slurry spray
- Staggered headers
- Single vessel penetration
- Excellent gas / liquid contact
- Excellent turndown
- Low pressure loss
- High reliability, low scale potential

Performance Enhancement Plates

Materials of Construction

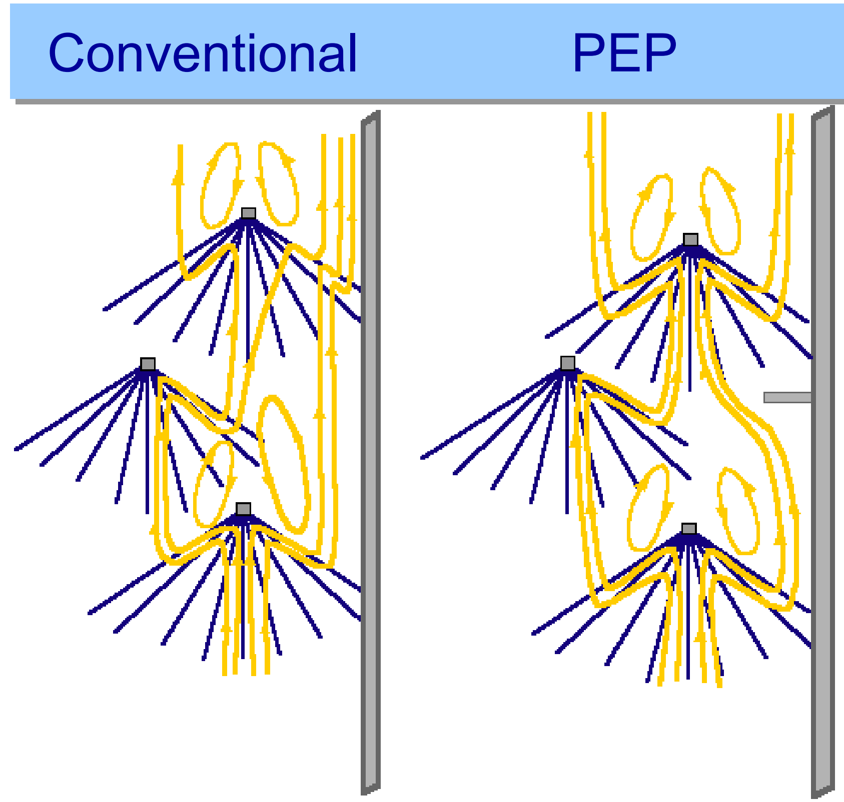
- FRP
- Metallic



High Efficiency with PEP

Performance Enhancement Plates (PEP)

- Prevents wall sneakage
- Reintroduce wall slurry
- Improves efficiency/ reduces L/G
- Power savings due to lower L/G
- FRP or alloy construction



Savings: 400-500 kW for 500 MW plant

Spray Zone SO_2 Mapping

ALSTOM

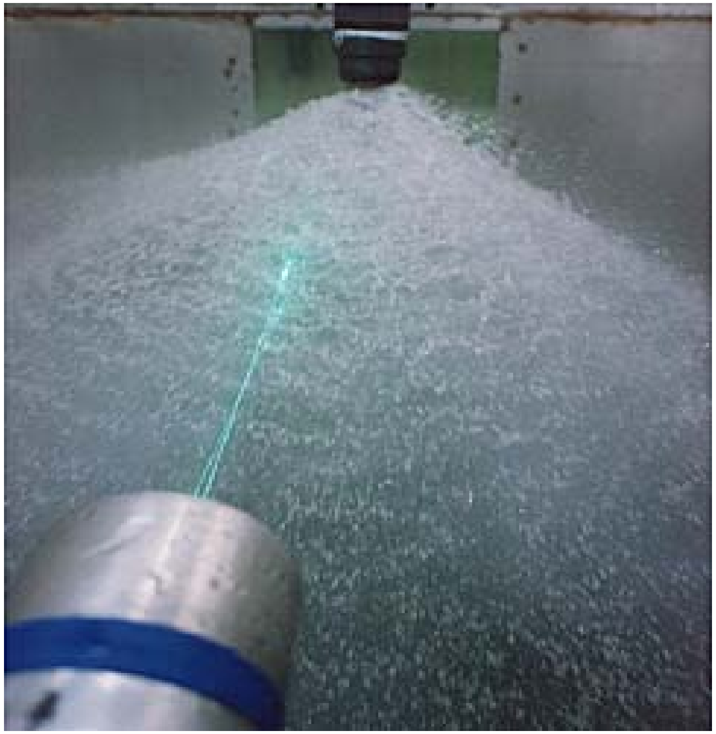
- Differential Optical Absorption Spectroscopy
  - Alstom proprietary
  - SO_2 measurement inside absorber
  - 1 inch space resolution
  - 5 ppm SO_2 resolution
- Computational Fluid Dynamics
- Test Facilities
  - Switzerland (Chemistry)
  - Sweden (Mass Transfer)
  - USA (CFD, Mist Eliminators)

Absorber Spray Nozzles

ALSTOM

Spray Nozzles

- Hollow cone, ramp style
- Nitride bonded silicon carbide
- 8 psig at 250-400 gpm
- 90-120° Spray cone angle
- 300-600% spray coverage
- Droplet size range 200-2000 microns



Laser Measurement of Droplet Size Distribution

Absorber Recycle Pumps

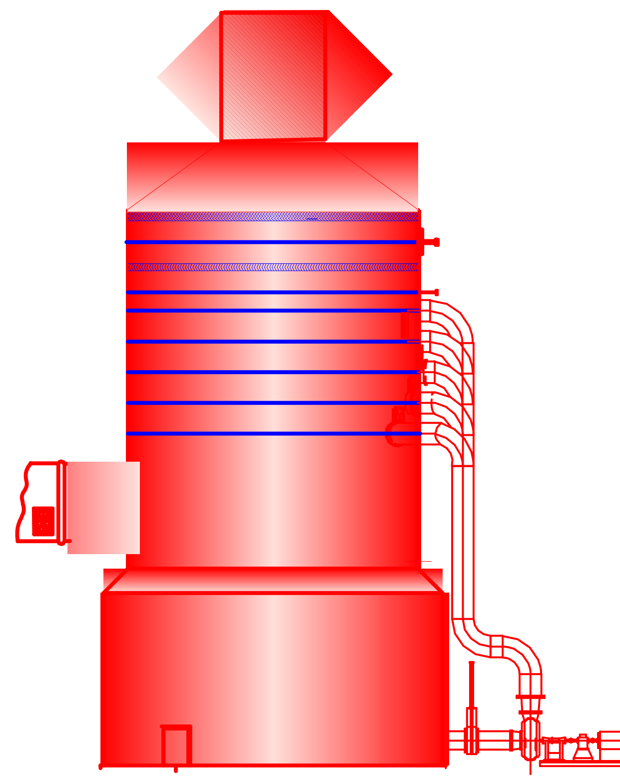
ALSTOM

Absorber Recycle Pumps

- Each pump has its own dedicated spray level
- Scrubber liquor flow can be tailored to system requirements to meet turndown needs.
- High availability with spare pump / level
- Heavy duty, high efficiency pumps (>90%)
- Newer, higher capacity pumps reduce FGD costs.

Advanced WFGD Features

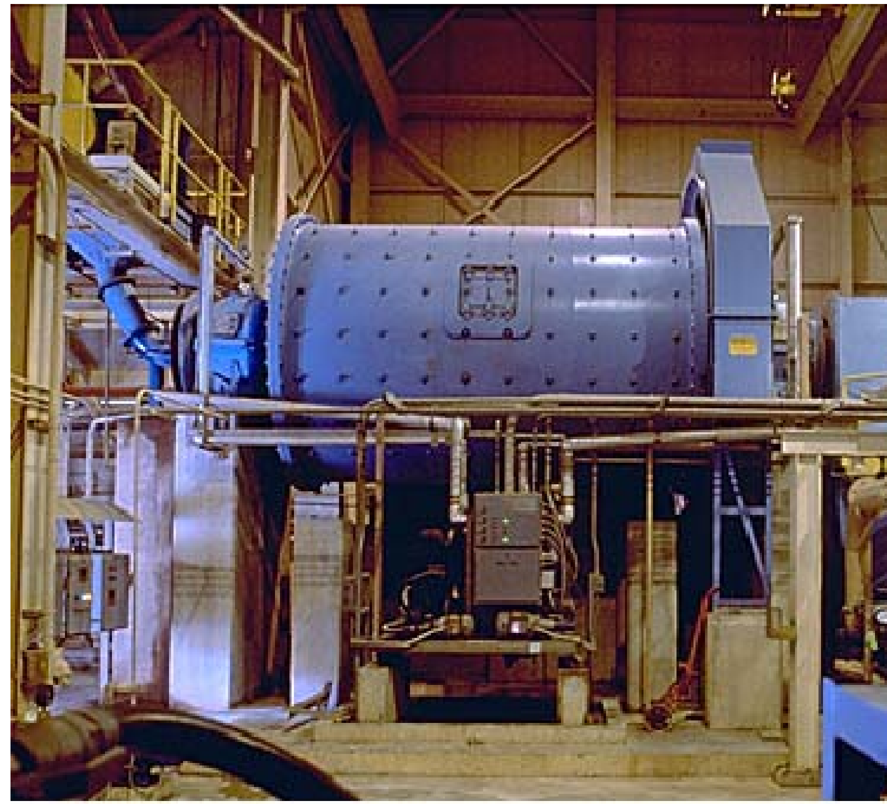
SO2 Removal:	97%-98%
Availability	97%-98%
Gas Velocity:	13.1 ft/sec (4.0 m/sec)
No. Spray Elevations:	3-4
Spray Zone:	High efficiency spray zone; PEP, Increased spray height
Spray Pumps:	Increased capacity: 72,000+ gpm each
Spare Absorber:	No
Absorber / Stack:	Combined
Mist Eliminators:	2+2 Plus, Koch, Munters
Materials:	Flakeglass or Rubber Lined CS, SS or Alloy C276 Roll-Clad
Oxidation:	Lance Injection
Reheat:	No
Byproduct:	Commercial gypsum



Limestone Preparation

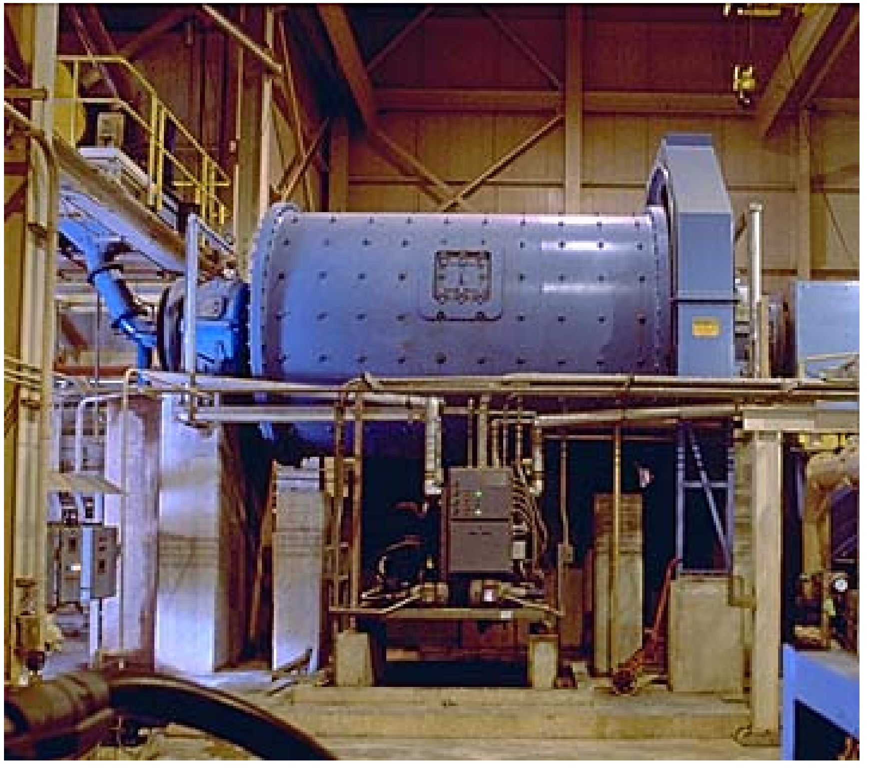
ALSTOM

- Limestone grinding
  - Horizontal/vertical wet ball mills
  - On-site vs. off-site preparation
- Product ground to 90-95% < 40 μ; 30-35% solids
- Rubber-lined with hardened steel balls



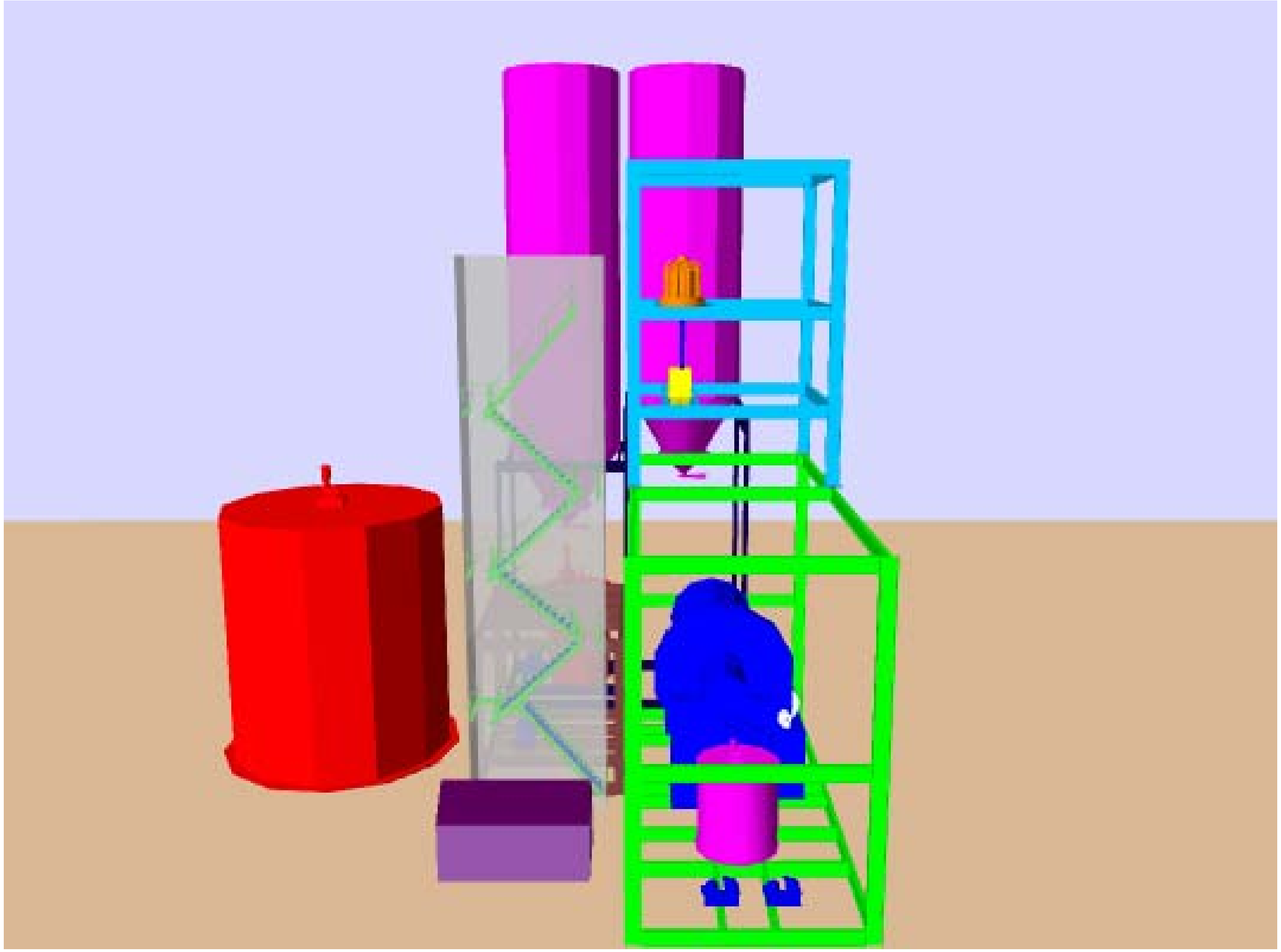
Single Ball Mill

- Single 100% capacity mill
- Pre-ground limestone silo provided in case of unplanned mill outage
- Most applicable to:
  - Smaller units (< 500 MW)
  - Lower sulfur coals (< 2% S)
- Careful consideration to:
  - Pre-ground limestone supply
  - Mill maintenance planning



Savings: $3-5 million

Limestone Preparation Island



Wallboard Gypsum Production

Typical specification:

- >95% $CaSO_4.2H_2O$
- <0.5-1.0% $CaSO_3.½H_2O$
- <100 ppm Cl
- <10% moisture
- pH 6 - 8
- 30-40µ MMD

Requires:

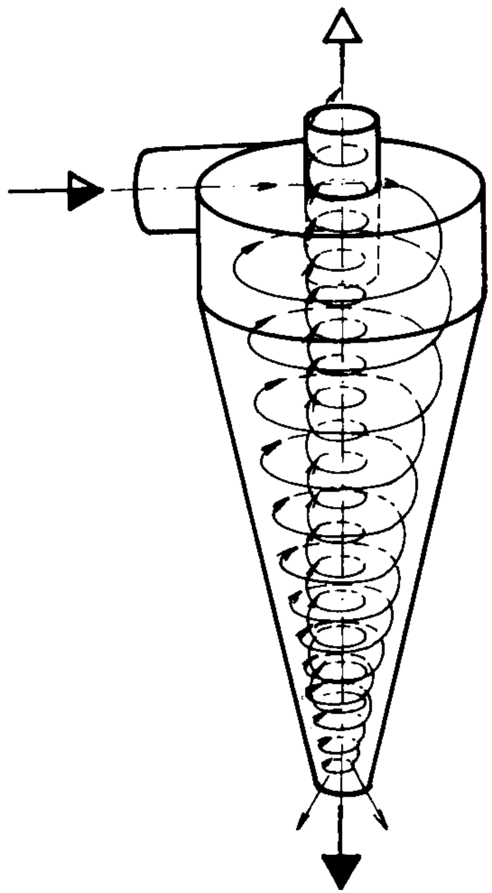
- High purity limestone (95-96%)
- High efficiency ESP
- 99+% oxidation
- Belt filter or centrifuge
- Cake washing/purge stream

Primary Dewatering

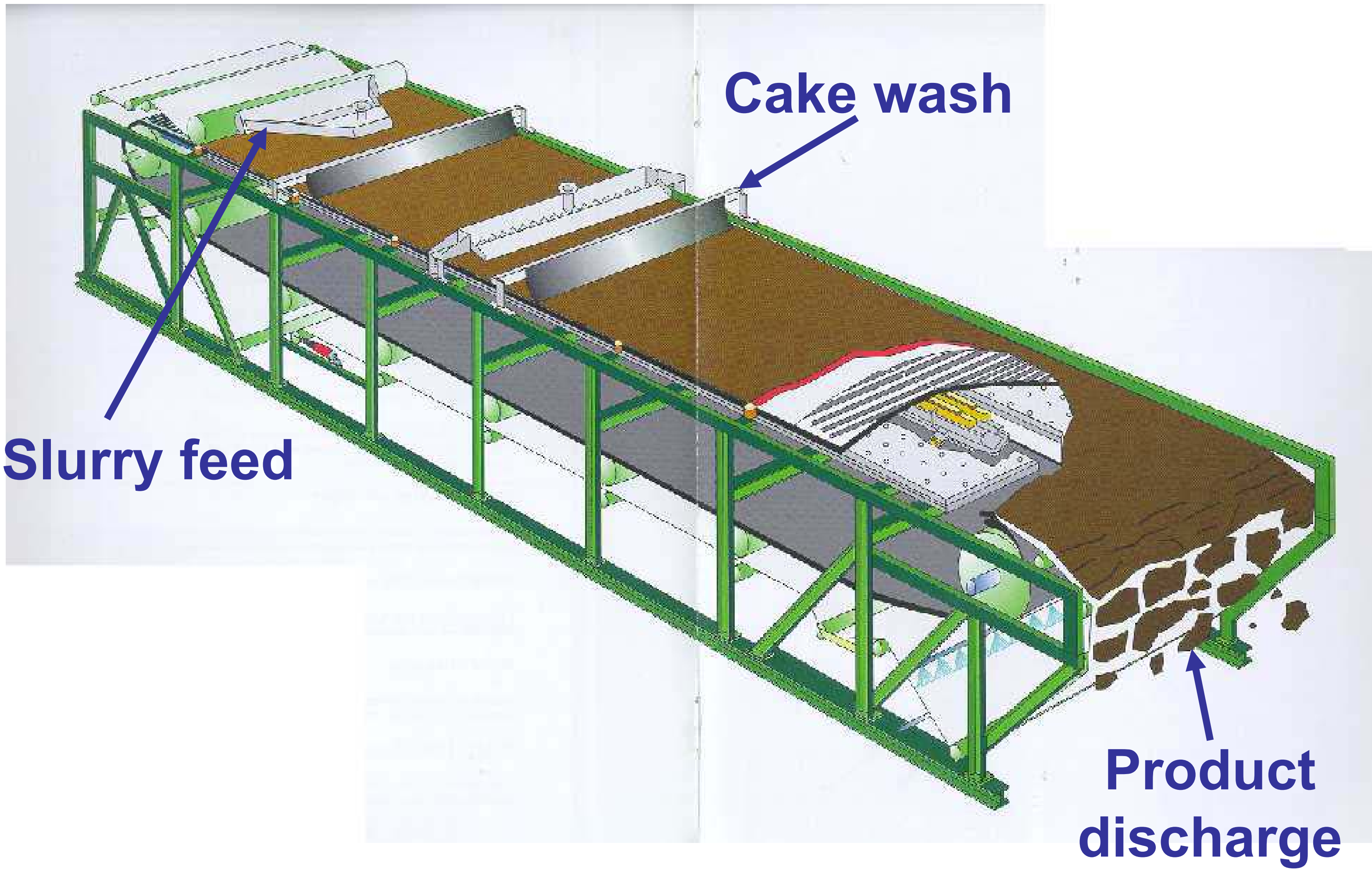
Gypsum Hydrocyclone:

- Heavy, coarse particles to underflow to secondary dewatering
- Lighter, fine particles to overflow including flyash, limestone
- No moving parts

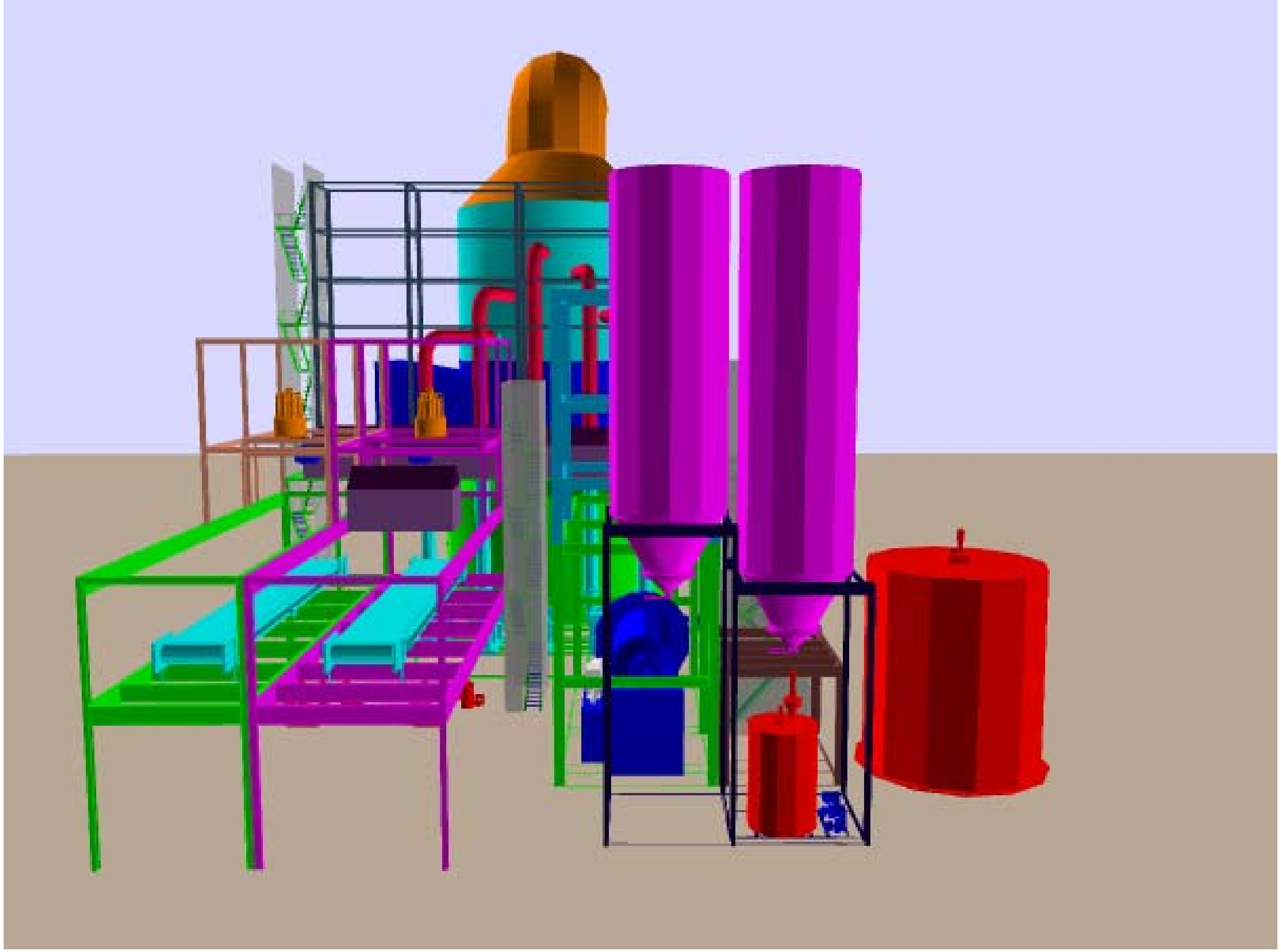
Hydrocyclone



Vacuum Belt Filter

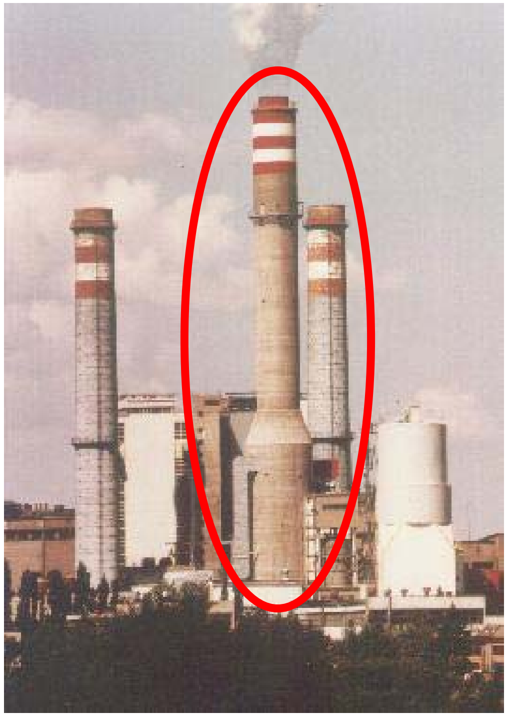


WFGD General Arrangement



Integrated Scrubber/Stack

- Absorber/chimney integrated into single structure
- Advantages:
  - Lower capital cost
  - Smaller footprint
  - Shorter construction duration
- Konin Units 7 & 8
  - 2 x 55 MW in Poland
  - Began operation in 1997
  - Rubber-lined/concrete construction



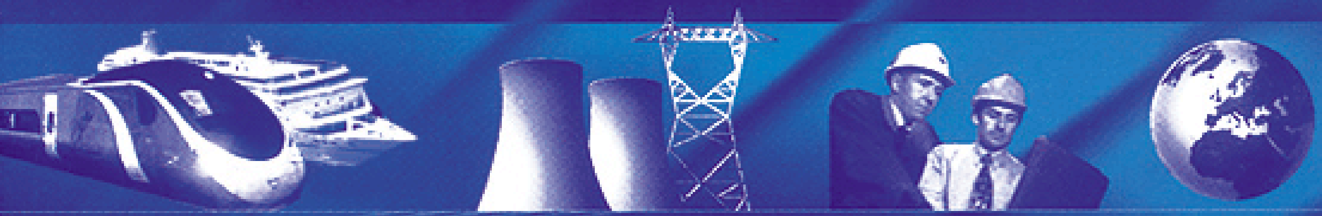
Regional Power Company of Poland
Konin Station Units 7&8 - 2 x 55 MW
Adamon, Konin, Poland

Savings: Up to $2-5 million; 1-2 months

Range of Experience

ALSTOM

Plant Size (MW):	175 to 2,600
Boiler Size (MW):	130 to 1,300
Fuel	Coal, lignite, Orimulsion, oil
Absorber Size (MW):	130 to 700
Sulfur Range (%):	0.5 to 4.5
SO_2 Inlet Concentration:	5,200 ppm / 15,000 mg/Nm^3
SO_2 Removal Efficiencies (%):	85 to 99
Reagent:	Limestone, Lime, Flyash
By-Product:	Gypsum, Landfill
Reheat:	Wet Stack, By-Pass, Indirect, Regenerative
Chlorides (ppm):	1,000 to 120,000
FGD Make-Up Water:	River, Lake, Plant Waste, Seawater



Recent WFGD Project Details

ALSTOM

Centralia Units 1 & 2

TransAlta

Project Scope	Consortium Alliance: absorbers, reagent prep, dewatering, ductwork, ID fan modifications, stack, buildings, electrical, DCS piping, BOP
Location	Washington, USA
Capacity	2 x 700 MW
Scheduled Start-Up	Unit 2 – Dec 31, 2001 Unit 1 – Dec 31, 2002
Commercial Operation	Unit 2 – Nov 16, 2001 Unit 1 – Dec 31, 2002
Fuel	1.05% sulfur coal
SO_2 Removal	91%
No. Absorbers	1 per boiler
No. Spray Levels	3+1
Absorber Size	58 ft. (17.7 m) dia.
Byproduct	Wallboard gypsum
Highlights	30 mo. Schedule; 317LMN absorber

TransAlta
Centralia Units 1 & 2 - 2 x 700 MW
Lewis County, WA

TransAlta Centralia Units 1 & 2

ALSTOM

Materials of Construction

Absorber	Solid 317 LMN
Reaction Tank	Solid 317 LMN
Internal Spray Headers	317 LMN
External Spray Pipe	FRP
PEP	317 LMN
Outlet Duct	Solid 317 LMN
Recycle Pumps	Rubber lined casing, metal impeller
Inlet Duct	Alloy 276 solid, 12 feet
Mist Eliminators	FRP, Munters
Mist Eliminator Wash Pipe / Nozzles	FRP
Oxidation Air Lances	317 LMN

Homer City Unit 3

Edison Mission Energy

ALSTOM Scope	Turnkey: absorbers, reagent prep, foundations, dewatering, ductwork, stack, buildings, electrical, piping, BOP, waste water treatment
Location	Pennsylvania, USA
Capacity	1 x 650 MW
Start-Up	Sept 2001
Fuel	3.7% sulfur coal
SO_2 Removal	98%
No. Absorbers	1
No. Spray Levels	4+1
Absorber Size	59 ft. (18.0 m) dia.
Byproduct	Wallboard gypsum
Highlights	29 mo. Schedule; C-276 roll-clad absorber; SCRs on Units 1, 2, & 3.

Edison Mission Energy
Homer City Unit 1 - 1 x 650 MW
Homer City, PA

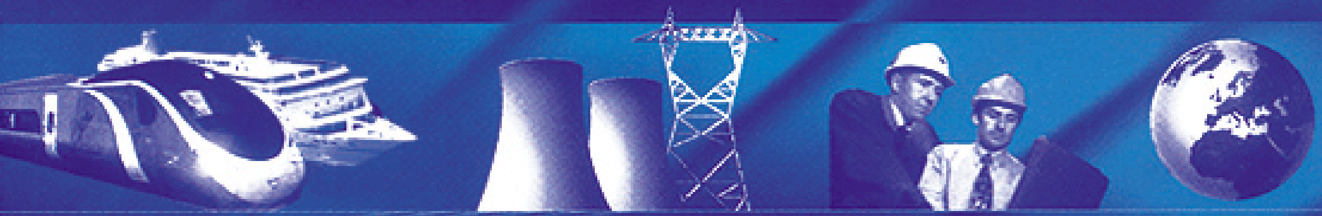
EME Homer City Unit 3

ALSTOM

Project Features

- Turnkey Alstom Project
- Award: April 17, 1999
- FGD In Service: September 21, 2001
- Performance Test: October, 2001
- Single 650 MW Absorber
- Wet FGD with SCR
- Construction Management: Alstom
- Contractors: Chattanooga Boiler & Tank, McCalls, Duke Fluor Daniel, MPS
- 29 Month Project Schedule

Edison Mission Energy
Homer City Unit 1 - 1 x 650 MW
Homer City, PA



Dry Flue Gas Desulfurization SDA and NID

ALSTOM

Alstom started DryFGD in 1980

ALSTOM

Dry Flue Gas Desulfurization
South Carolina Electric & Gas
Cope Unit 1, 385 MW

- More than 20 years of experience in Dry FGD
- More than 120 systems installed today
- Rotary SDA, Nozzle SDA, Fluidized bed and NID systems for all kind of different fuels in operation

A History of Dry FGD Systems

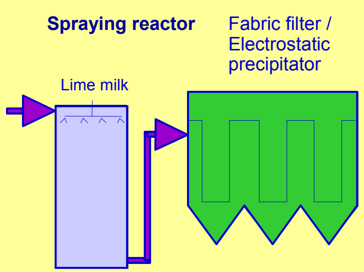
100%

50%

0%

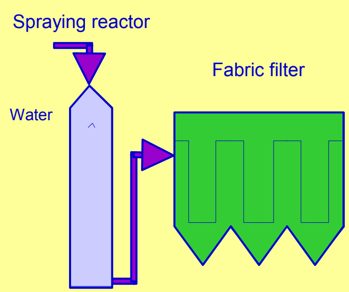
Spray absorption

- Very big reactor
  H↑ D↓
- Dust separator
- High energy consumption because of rotary atomizer or spray nozzles
- Handling of lime milk
- Absorbens: limestone



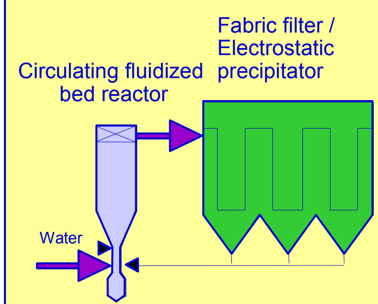
Dry absorption with spray cooler

- High cooling tower
  H↑ D↓
- Dust separator
- No lime milk
- Absorbens:
  calcium hydrate



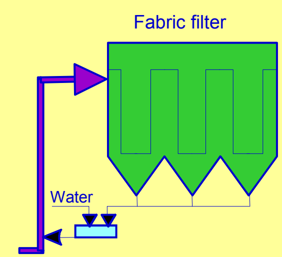
Circulating fluidized bed

- Small reactor
- Dust separator
- No lime milk, but $Ca(OH)_2$
- Absorbens: calcium hydrate



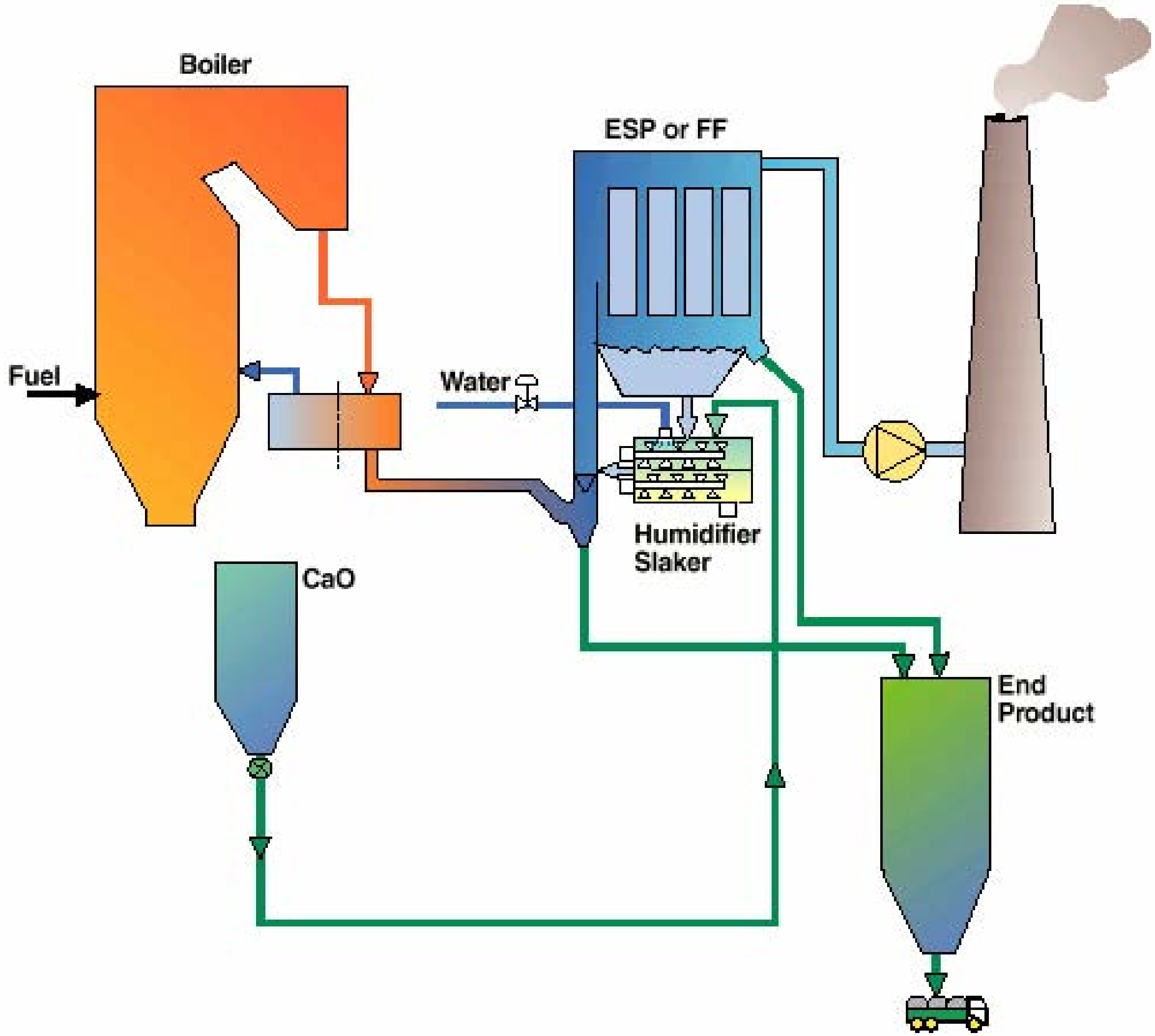
NID

- <u>No separate reactor</u>
- Dust separator = reactor
- No lime milk
- Absorbens: quick lime



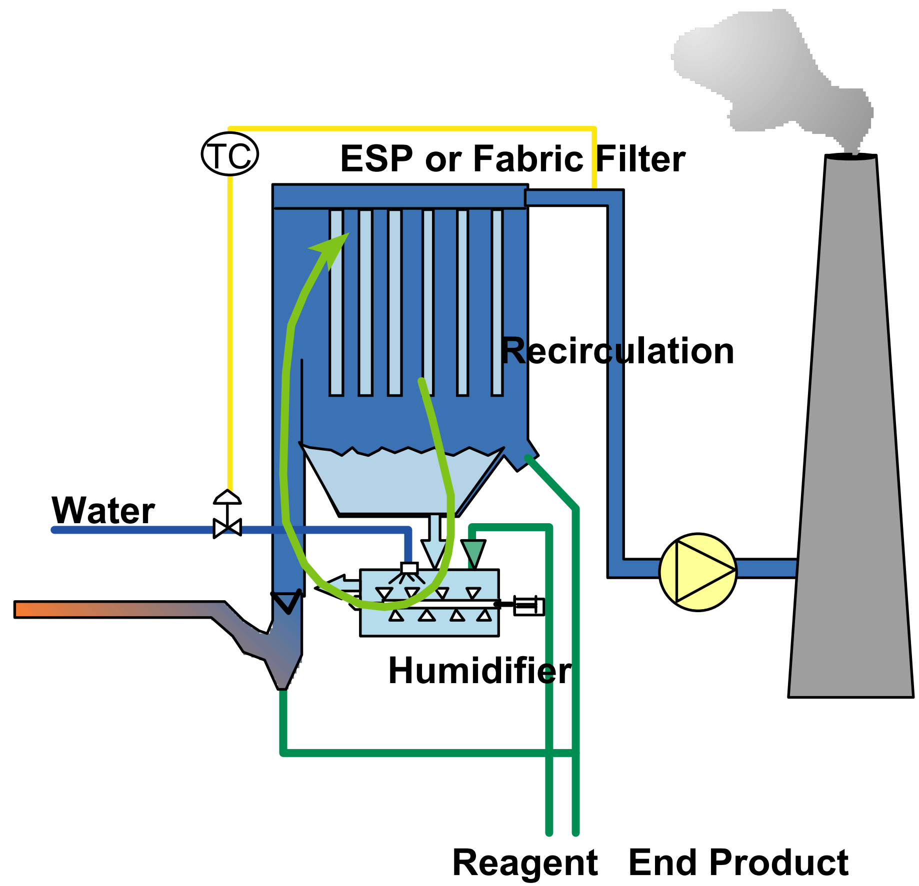
Alstom’s DryFGD in 2003

The NID Process

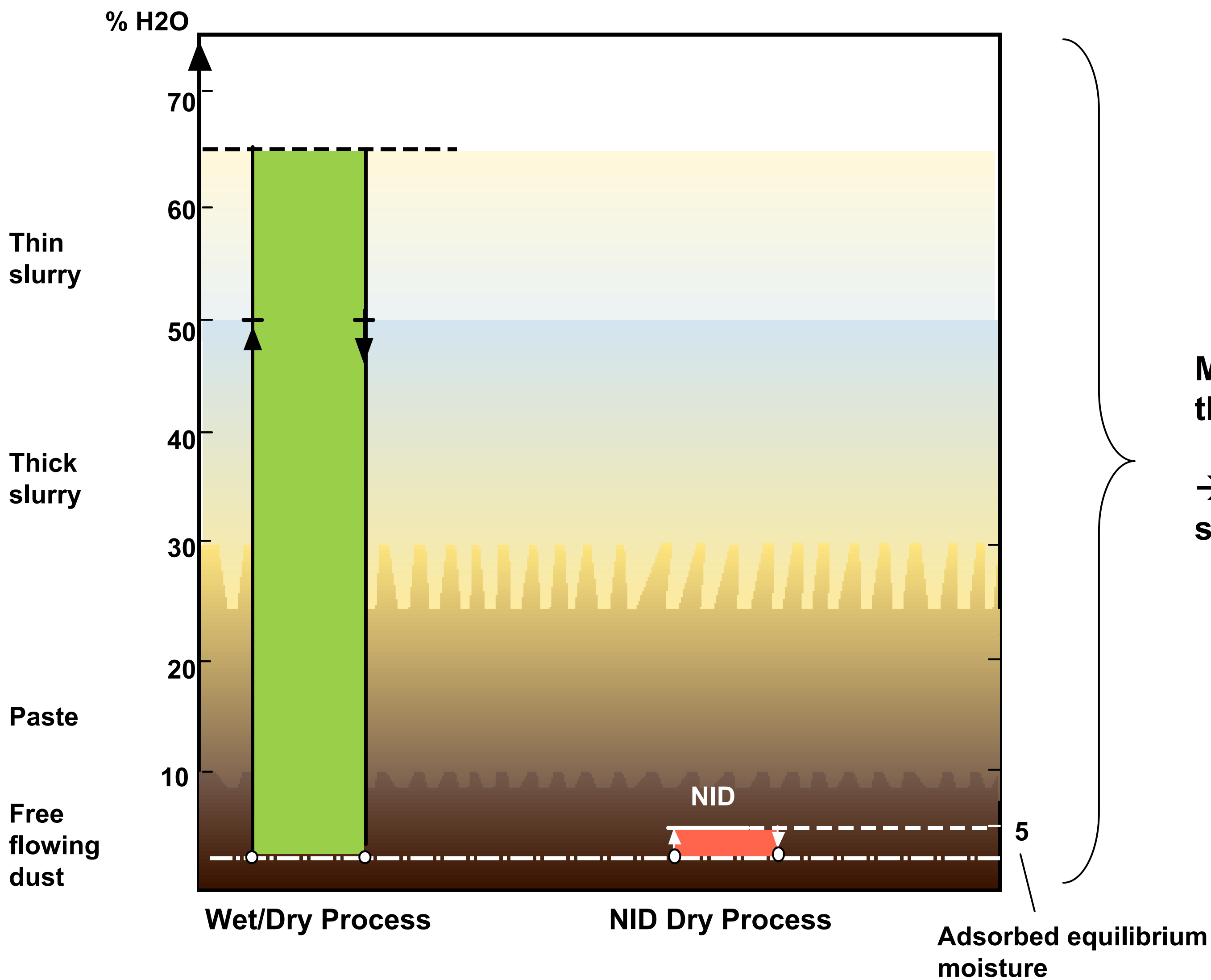


NID Process Concept

- Very high recirculation
- No slurry handling
- Direct usage of CaO
- “Dry” product
- High utilization of reagent



SDA and NID – Moisture Content in Dust



Much less water is in the recirculation loop.

→ Energy and cost savings.

NID Design Parameters

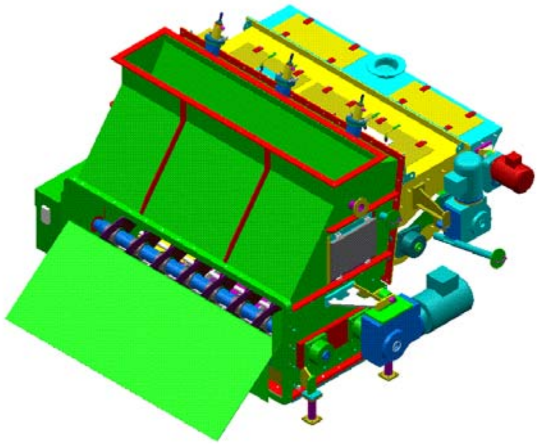
ALSTOM

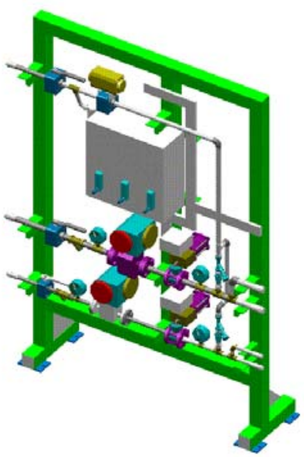
- Flue Gas SO_2 Content
  - Tested up to 3500 ppm
  - Most applications are for low and medium sulfur coal.
- Flue Gas Inlet Temperature
  - Low temp preferred; max approx.. 200 °C
- Gas flow
  - Operating range from 20,000 Nm3/h
  - Single Reactor module up to Nm3/h
  - Parallel reactors for higher flows

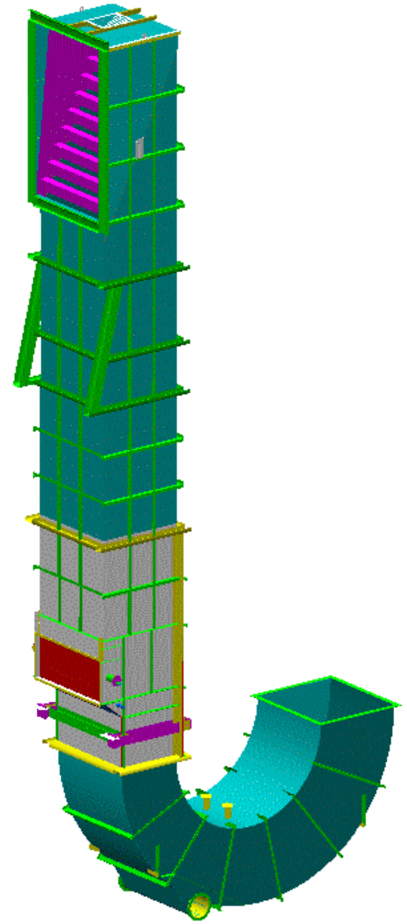
NID – Advantages

- Integrated FGD and ESP or Fabric Filter saves space
- High SO2 removal efficiency
- Lower operating cost than comparable systems
- Lower investment than ESP + Wet FGD
- No separate Dust Removal system necessary
- Less maintenance due to less equipment
- Less maintenance due to no corrosion - No water spraying and 100 % removal of SO3.

NID Standardised components

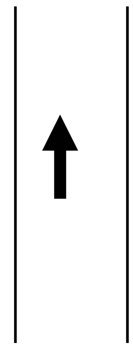






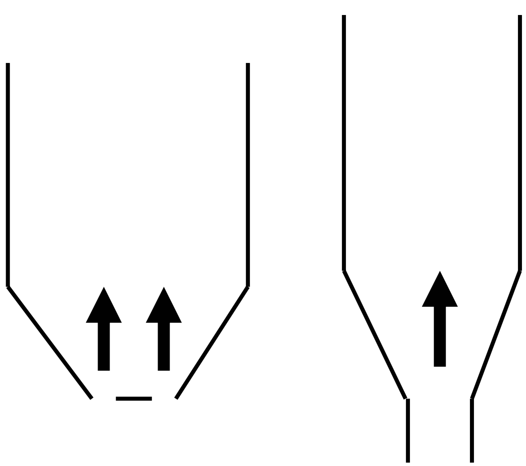
Reactor layout (NID & others)

NID



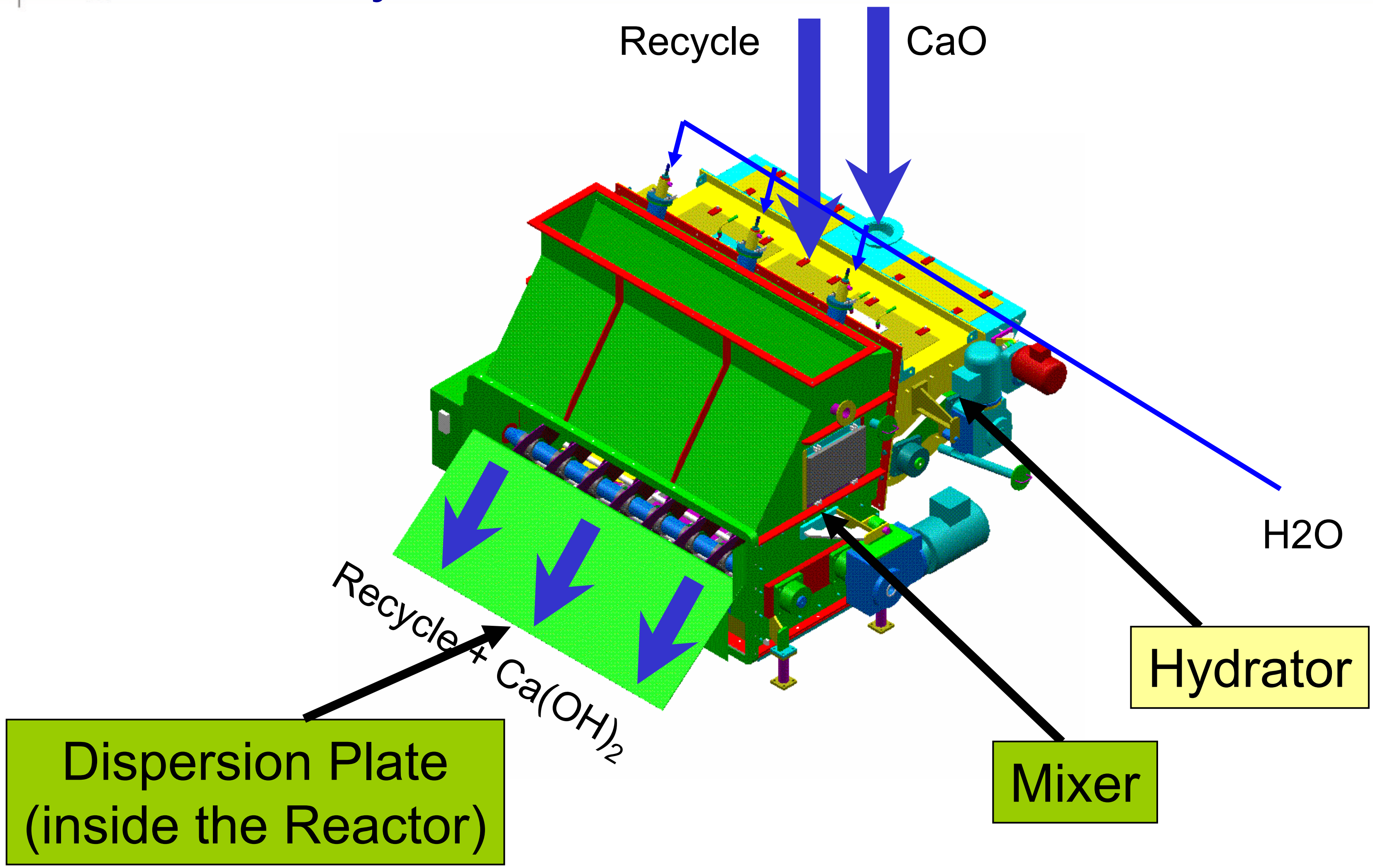
- Same flow velocity in whole reactor.
- Same lifting force all the time
- Agglomerates are following the flow
- No water spraying inside reactor/flue gas

Other

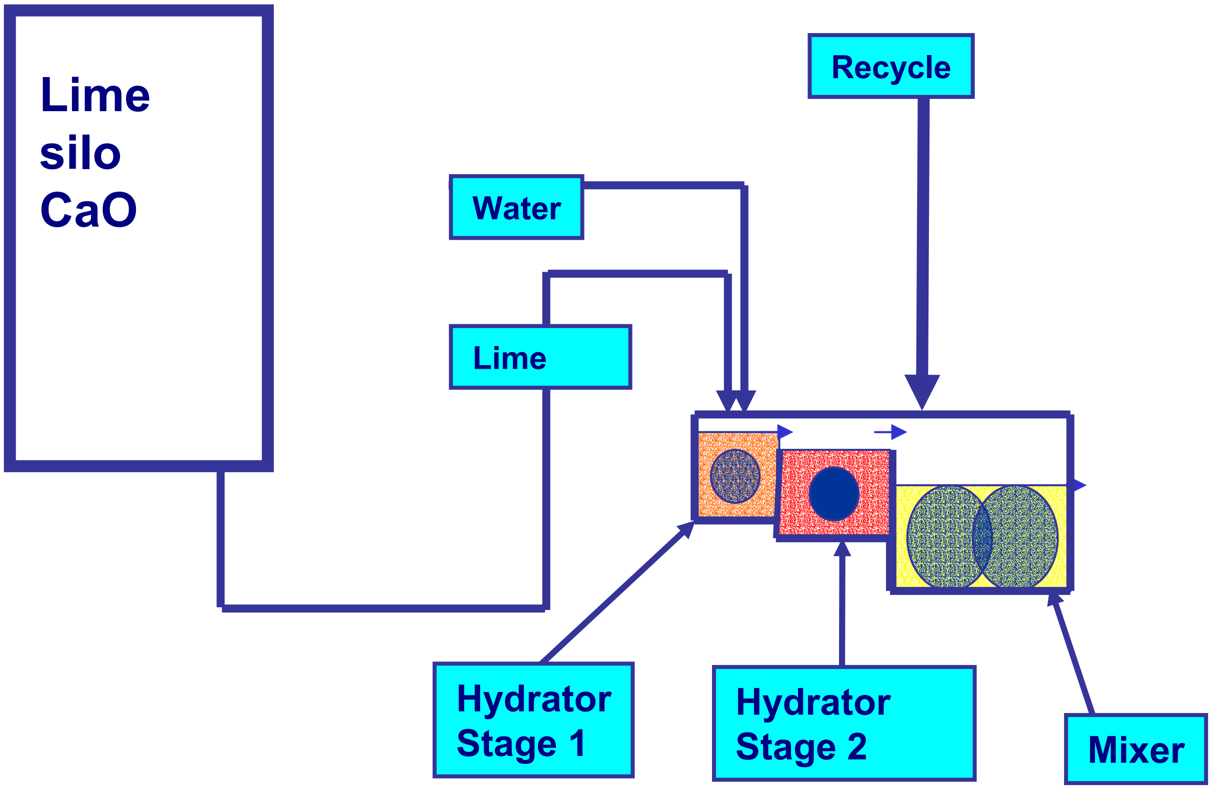


- Lower velocity in upper part of reactor, acceleration through venturi
- Lower lifting force in upper part
- Agglomerates are to a higher extend collected in the reactor and can't leave it
- Water addition inside reactor

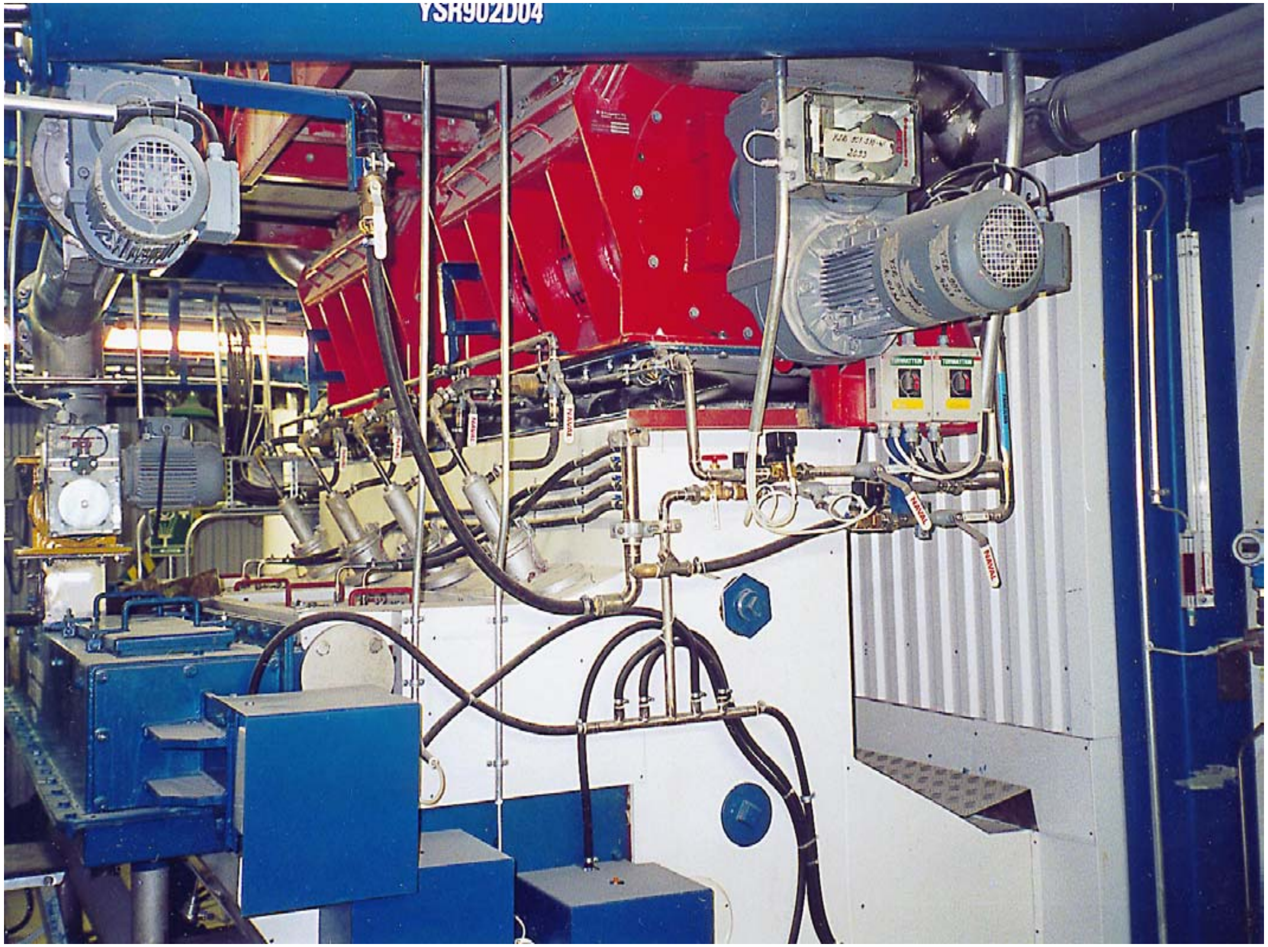
NID Equipment
Mixer/Hydrator



NID Integrated Lime Hydrator Principle



Mixer/Hydrator installation



NID Equipment - Mixer

- Mechanically Stirred Fluidised Bed
- Low Specific Power Consumption enables a Very Large Capacity per unit
- Positive wetting of all recycle as opposed to other system with wetting inside Reactor.
- Enabling factor for CFB + NID; residence time in mixer is long enough to allow activation of ash, in total 15 - 25 minutes (20 s x no. of passes)

Journey through the NID Reference List

I. NID and ESP

II. NID and Fabric Filter

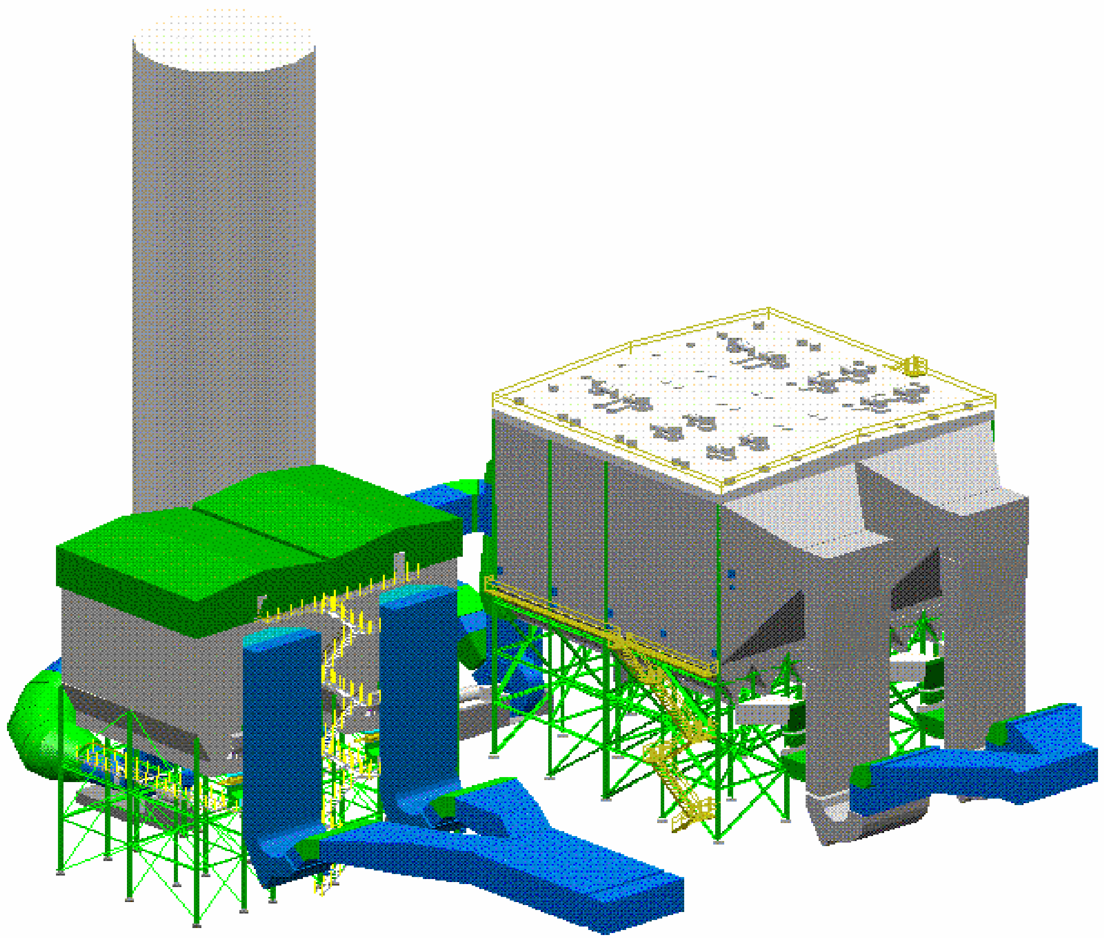
III. NID for Waste to Energy Plants

IV. CFB Boiler and NID

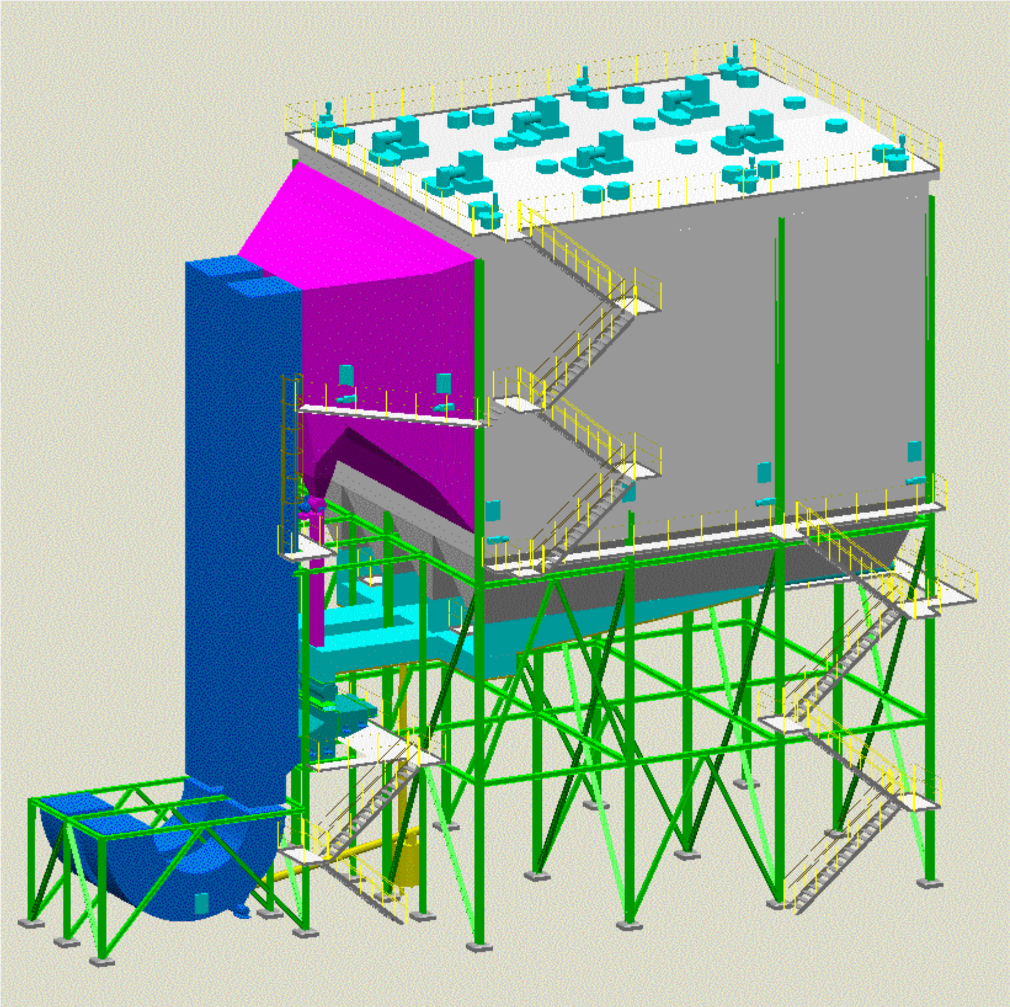
NID Reference Plants Power

Plant	Fuel	Nm3/h	Year
Laziska, PL	Coal	2 x 518,000	96/97
Vaasa, FI	Diesel	145,000	1998
Nuremberg, DE	Coal	168,200	1999
Fifoots Point, UK	Coal	3 x 450,000	2000
Zhejiang #8, CN	Coal	330,000	2001
Mai Liao RF-1, TW	Petcoke	2 x 511,500	2002
Seward, US	Coal	2 x 930,000	2004
Gilbert, US	Coal	900,000	2004
Elektrenai #8, LI	Orimulsion	520,000	2004
HuaYingShan, CN	Coal	451.000	2003
Baotou #2, CN	Coal	850,000	2004

NID End Collector Options
FF and ESP

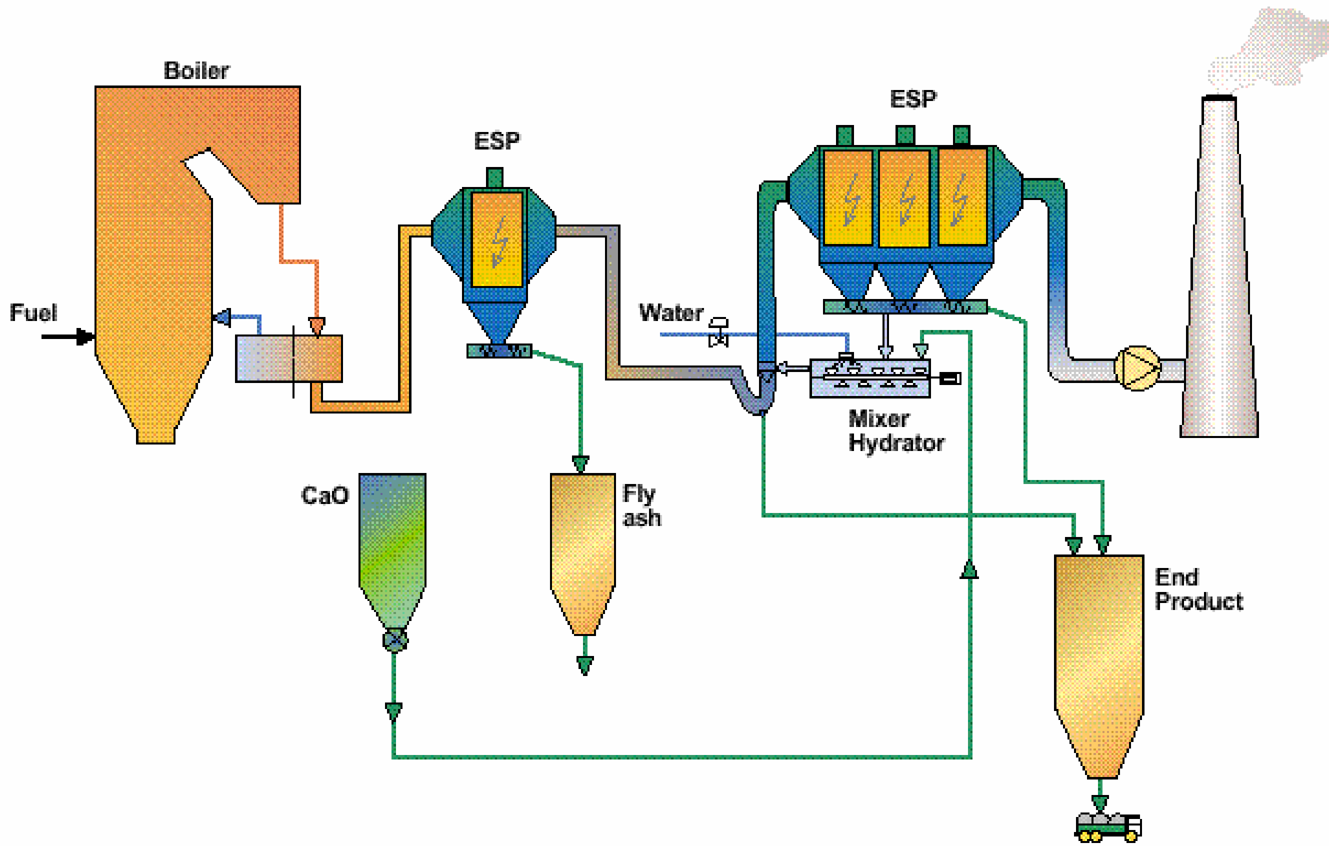


NID + ESP



NID-ESP, Juhua Group Co.
P. R. China

Zhejiang, Juhua Group Co.
Process description boiler No 8



Zhejiang, Juhua Group Co.
NID plant data boiler No 8

Power production	Steam plus 55 MWe
Main fuel	Coal
Flue gas flow	330 000 Nm^3/h
Temperature	148 °C
Inlet SO_2	max. 1 100 ppm
SO_2 removal efficiency	85 %
Absorbent	$Ca(OH)_2$ alternatively CaO
Dust emission, outlet NID	max. 200 mg/Nm^3
End product conveying	Dense phase pneumatic system
End product	Landfill
In operation	Year 2001

NID ESP Design specials

- Low operating temperature -> insulation

- High dust load -> purging, rapping

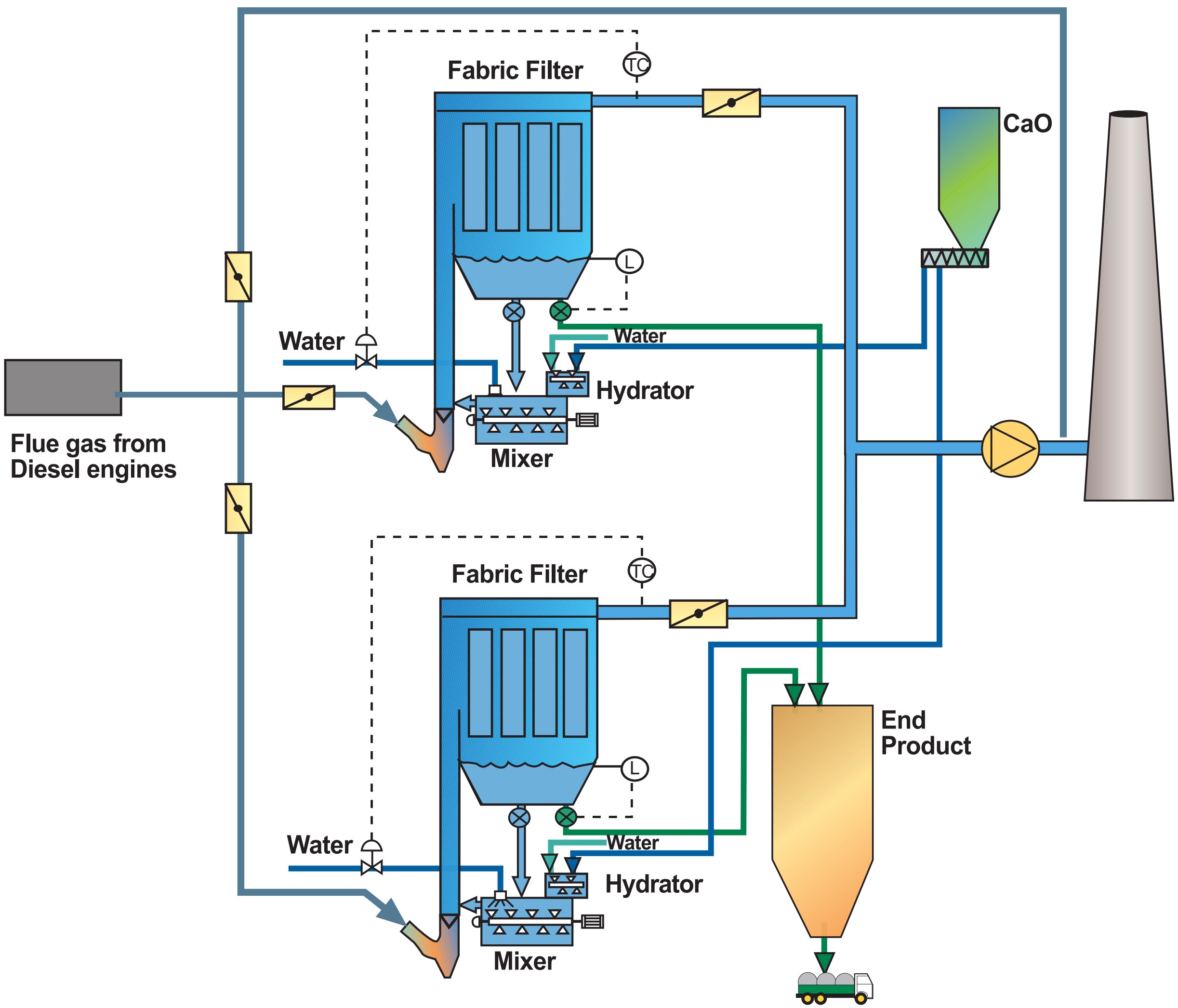
- Control and rectifiers
  - EPIC II control
  - T/R of correct size

- Slightly higher ESP power consumption than in operation with low resistive coal

- Sizing of ESP: For coal case and NID case

NID + Fabric Filter

Vaasa Diesel Power Plant process description



Vaasa Diesel Power Plant

EWAG Nürnberg
Replacement of SDA with NID

EWAG Nürnberg
NID basic plant data

ALSTOM

Power production	114 MWt
Main fuel	Coal
Flue gas flow	157 000 Nm^3/h
Temperature	140 °C
Inlet SO_2	1800 mg/Nm^3
Outlet SO_2	max. 180 mg/Nm^3
Absorbent	CaO
Dust emission, outlet NID	max. 10 mg/Nm^3
End product conveying	Dense phase pneumatic system
End product	Landfill
In operation	Year 1999

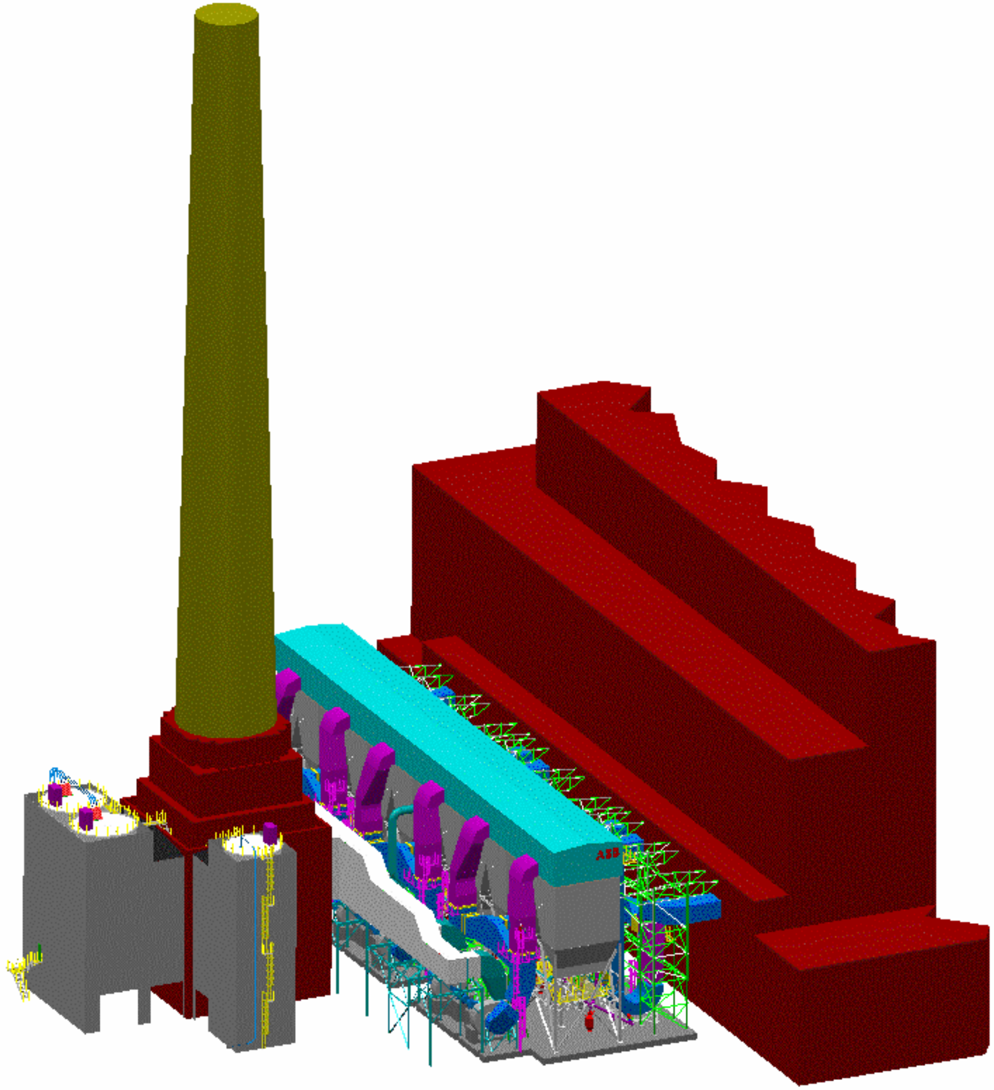
NID – Laziska Basic Plant Data

Power production	2 x 120 MW
Main fuel	Coal, max 1.4% S
Flue gas flow	2 x 518.000 Nm3/h
Temperature, max	165°C
SO2 inlet	1,500 – 4,000 mg/Nm3
SO2 removal efficiency	80% (guaranteed)
SO2 removal efficiency	95% (measured)
Absorbent	CaO
Dust load, inlet NID	22,000 mg/Nm3 (no precollector
Dust emission, outlet NID	50 mg/Nm3 (guaranteed)
Dust emission, outlet NID	15 mg/Nm3 (measured)
End product utilisation	Stabilisate/fire prevention in coal mines
End product conveying	Dense phase pneumatic system
Conveying distance	1,200 m (tested)

Fifoots Point - Exterior

ALSTOM

AES Fifoots Point
NID Layout



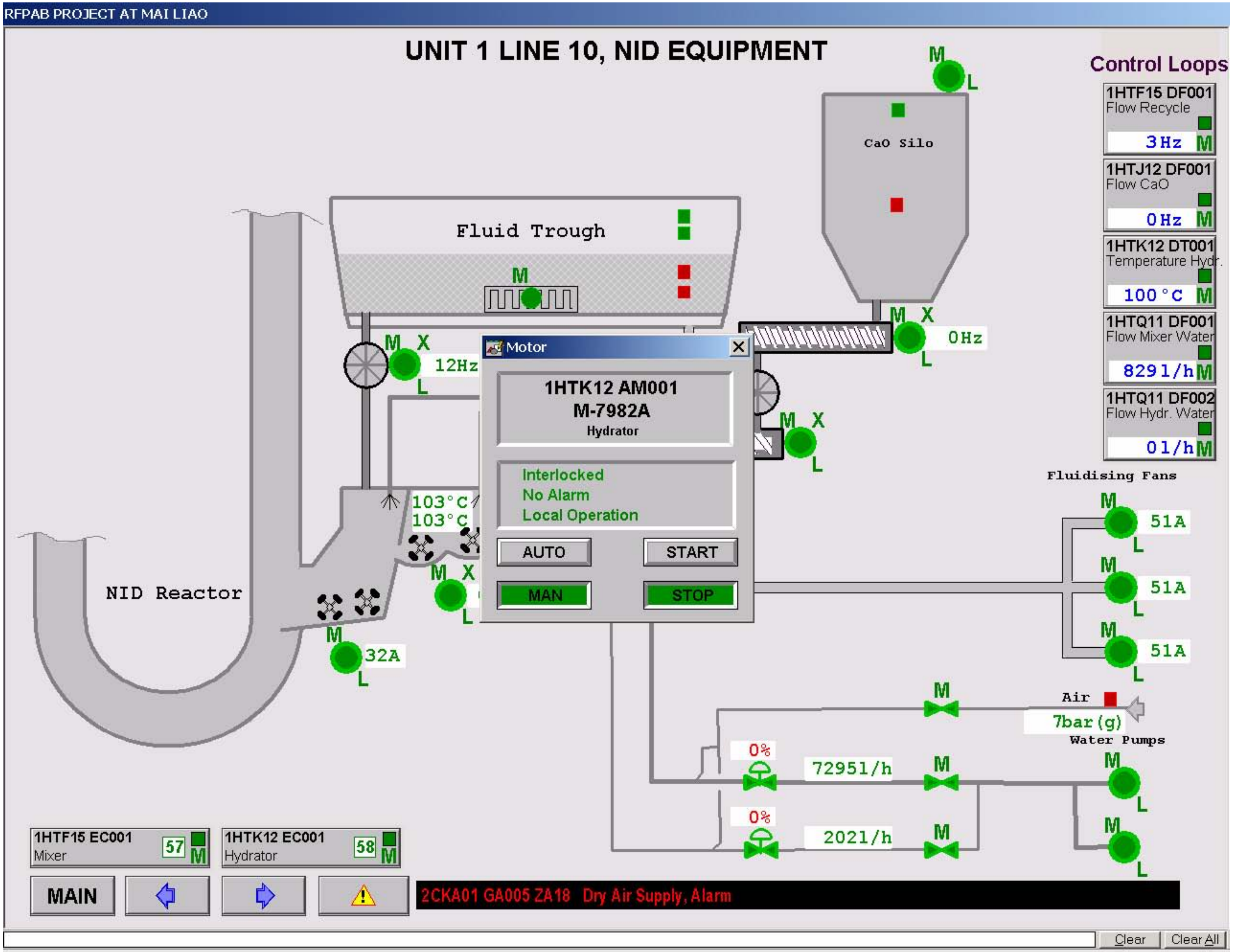
NID – Fifoots Point Plant Data

Power production	3 x 120 MW
Main fuel	Coal, 1.2% S
Flue gas flow	3 x 450.000 Nm3/h
Temperature	133°C
SO2 inlet	800 ppm
SO2 removal efficiency	80% (guaranteed)
Absorbent	CaO
Dust emission, outlet NID	25 mg/Nm3 (guaranteed)
End product conveying	Dense phase pneumatic system

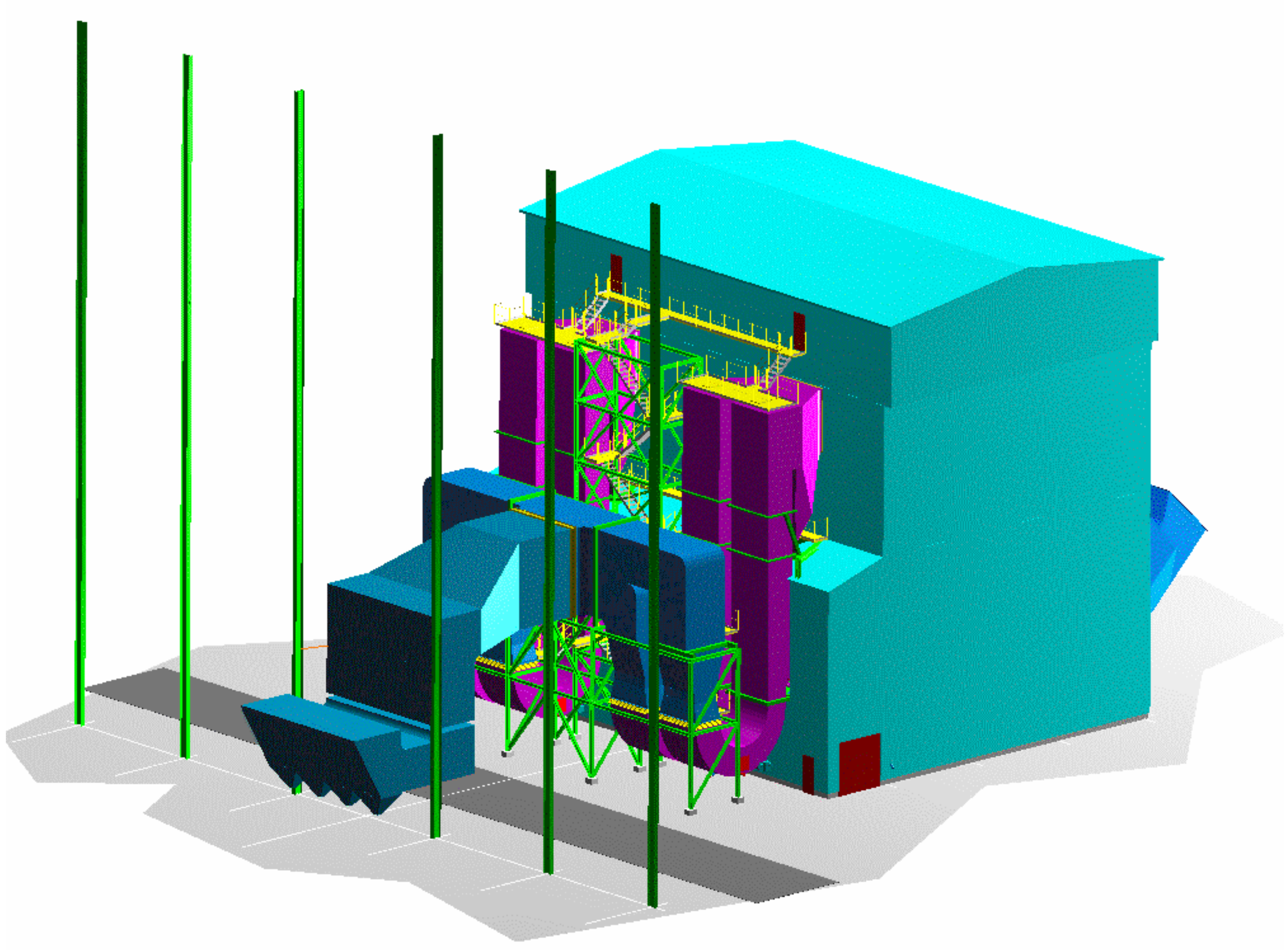
Mai Liao Site sept 2002

ALSTOM

Mai Laio - Control Screen



Seward, USA
NID for CFB 2*250 MW

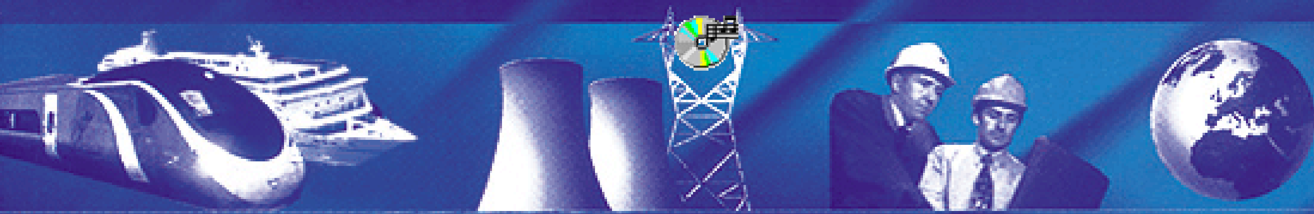


Seward, USA
NID - Technical data

Type	CFB + NID	
Size	2*250	MWel
Gas flow	2*906 000	Nm³/h
In operation	Dec 2003	
Emissions guarantees		
Dust	10	mg/Nm³
SO2 emission	318	ppm
SO2 removal overall (Boiler + NID)	95	%

ALSTOM Technology moves on

NID Pilot Plant in Alstom's Laboratory:
R+D test runs lead to new developments



ALSTOM Seawater FGD

30 years operation and development

ALSTOM

Successful applications

ALSTOM

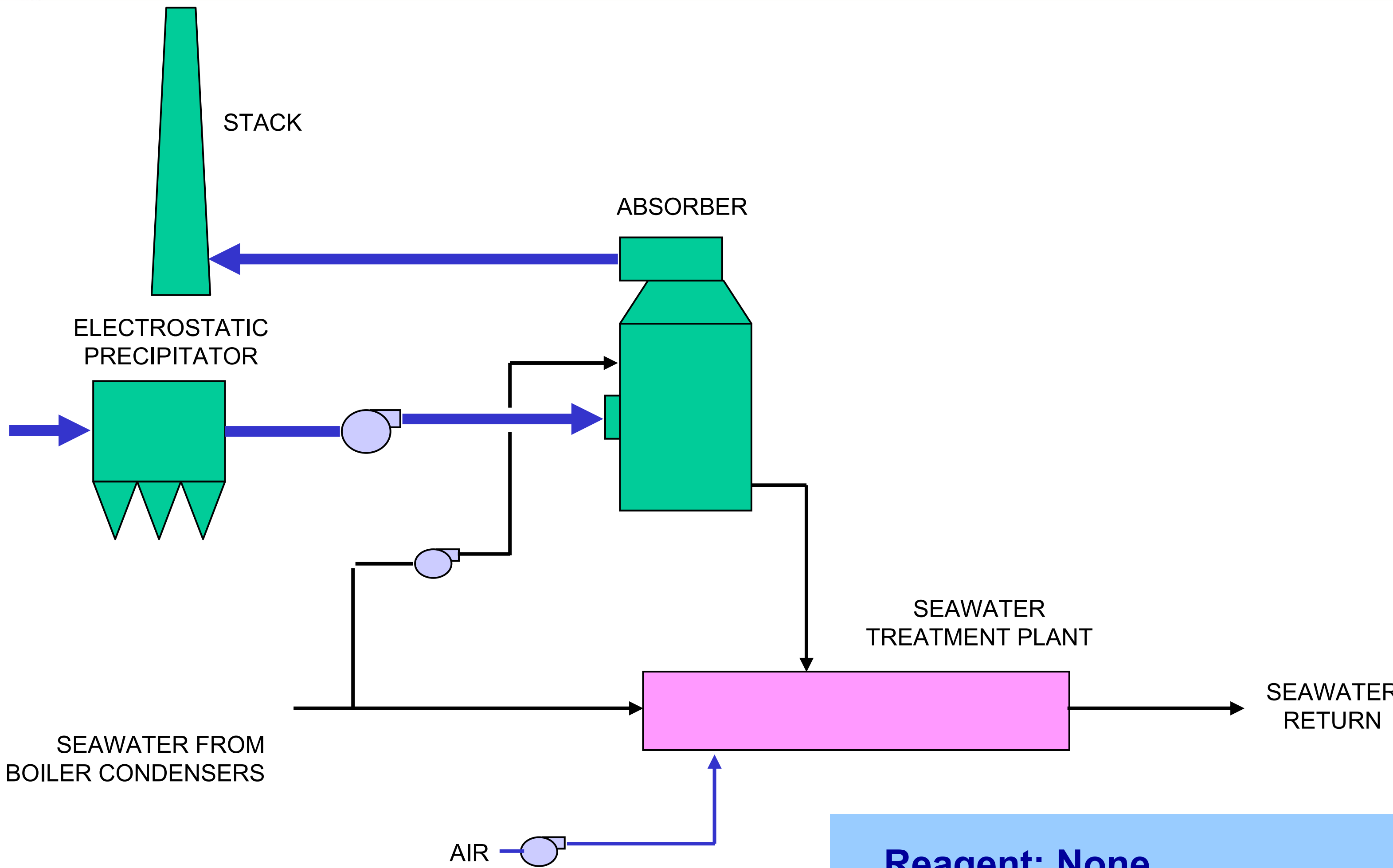
Seawater available
Low-medium sulfur content

Coal and Oil-fired Power Stations

Metal smelters

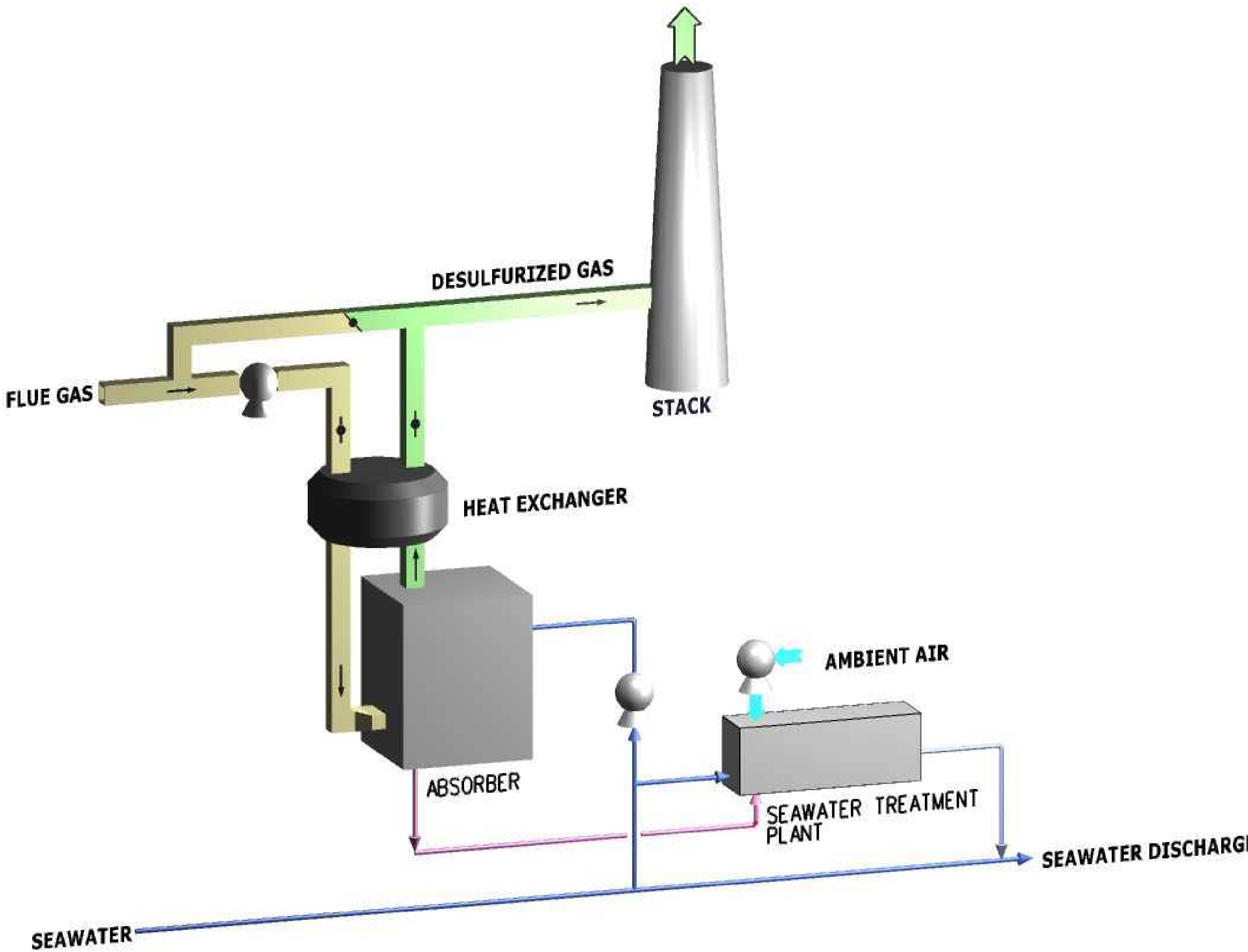
Oil industry

Seawater FGD Process Diagram

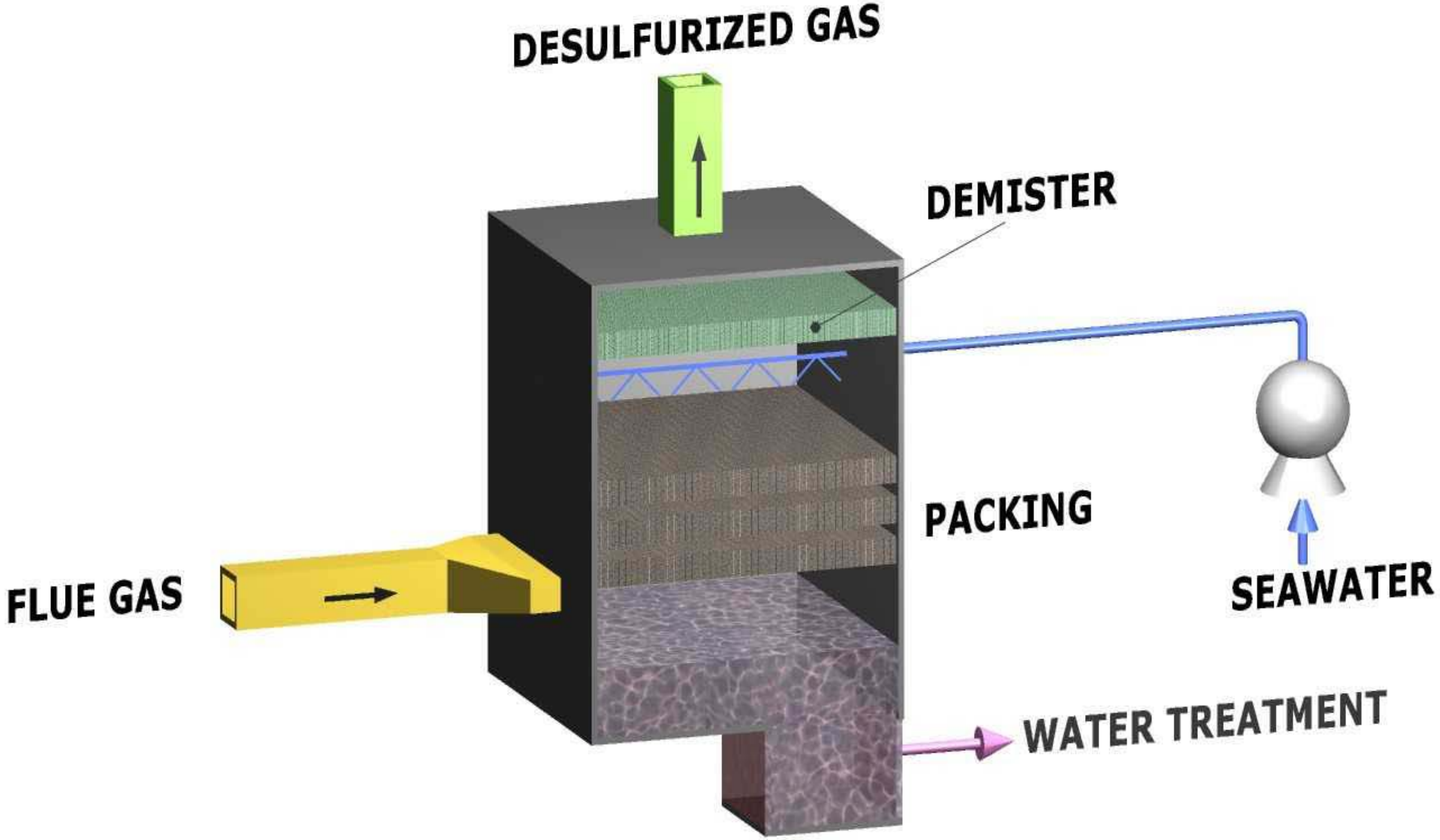


Reagent: None
Byproduct: None
Efficiency: >95%, Low/Med. S

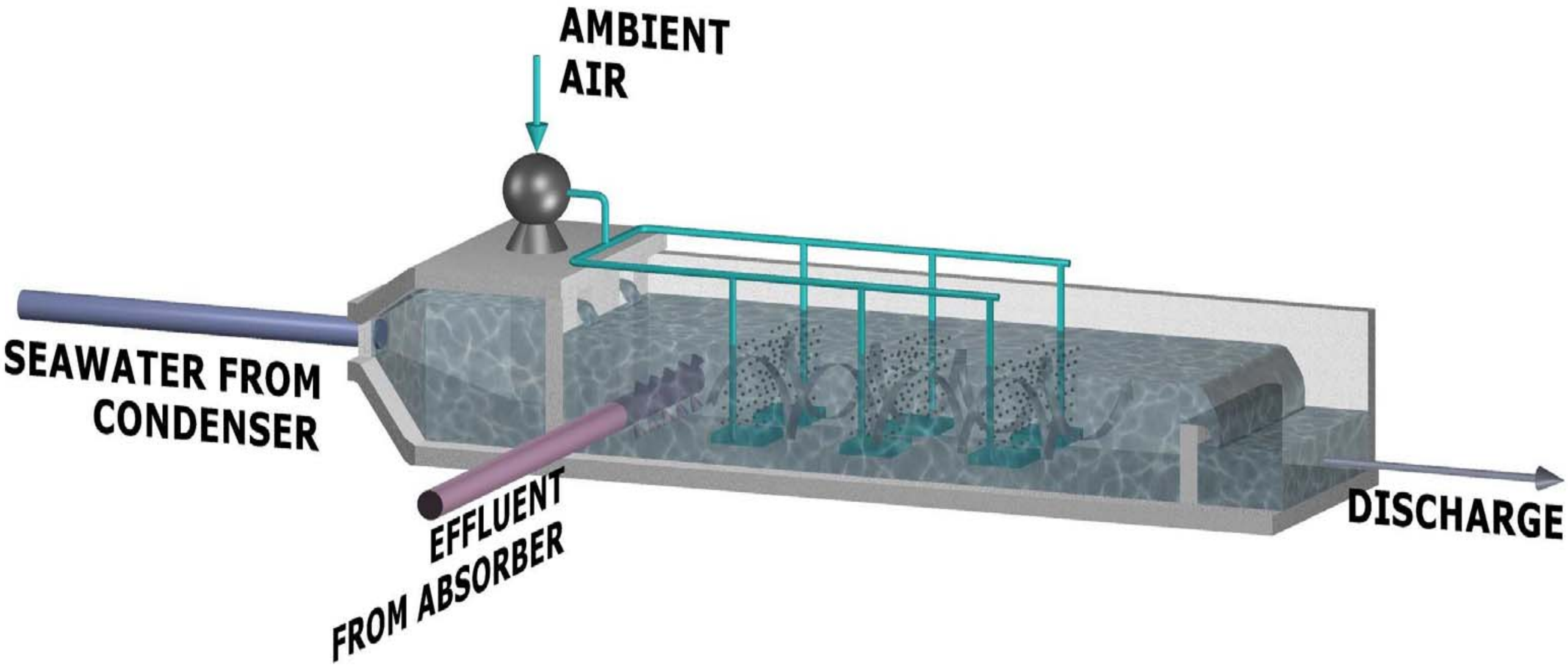
Process flow



Absorber design

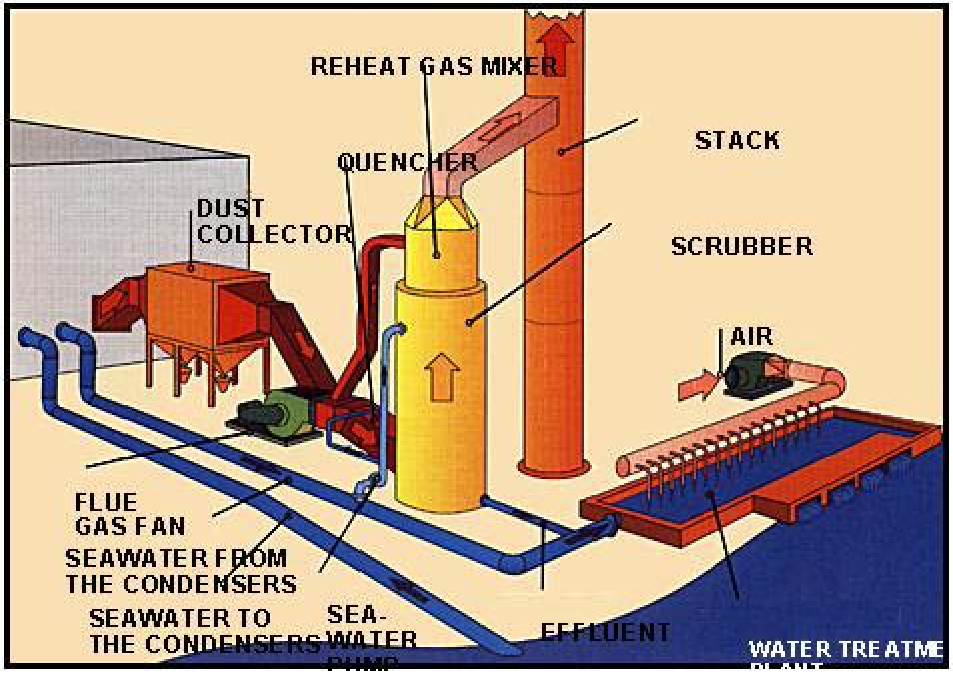


Water treatment plant



Seawater FGD

- Utilizes natural alkalinity of seawater
- High efficiency via packed tower
- No reagent, no byproduct
- Effluent treated via oxidation prior to discharge

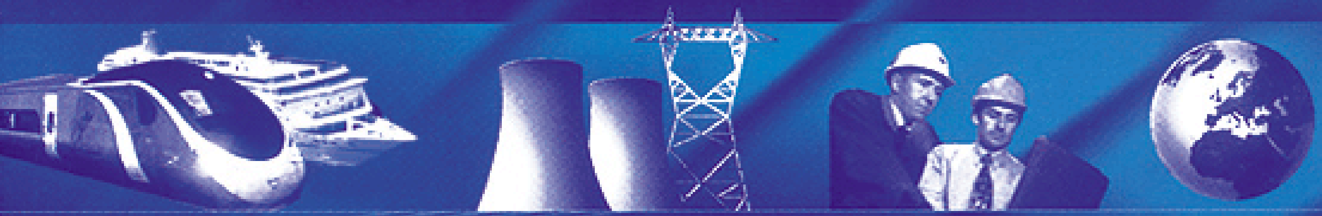


Recent SWFGD References

Customer	Fuel	MW	Start-Up
UNELCO Tenerife, SP	Oil	2 x 160	1995
Shenzhen West Power Unit 4, CN	Coal	300	1998
Mitsui Paiton, ID	Coal	2 x 670	1998/1999
TNBJ Manjung, MY	Coal	3 x 700	2002/2003
Shenzhen West Power Unit 5 + 6, CN	Coal	2 x 300	2004
Vasilikos II EA Cyprus	Oil	130	2005

Over 8,000 MW Operating or Under Contract

Shenzen West SWFGD



Summary

FGD Alternatives

ALSTOM

	WFGD	DFGD - SDA	DFGD - NID	SWFGD
Installed Capacity	33,000 MW	12,000 MW	3,000 MW	8,000 MW
First Installation	1968	1980	1996	1968
Reagent	Limestone	Lime	Lime (Limestone with CFB)	Seawater
Byproduct	Salable gypsum or landfill	Landfill	Landfill or Use in Cement/Road Constr	Treated Seawater
Sulfur	<6%	<2.5%	<6%	<2%
Removal Efficiency	>98%	90-95%	90-95% (98% w/CFB)	>95%
Footprint	Small in power island area; large overall	Large in power island area; small overall	Small in power island area and overall	Small in power island area; moderate overall
Pros	• Low cost reagent • Marketable byproduct • Large reference list • Fuel flexibility • Ease of retrofit	• Low capital cost • Low power consumption • Dry byproduct • Operational simplicity, medium maintenance costs	• Low capital cost • Low power consumption • Dry byproduct • Operational simplicity, low maintenance costs	• No reagent • No byproduct • Fuel flexibility
Cons	• High capital cost • High power consumption	• High cost reagent • Byproduct use limited	• High cost reagent • Byproduct use limited	• Moderate capital cost • Effluent discharge • Limited applicability

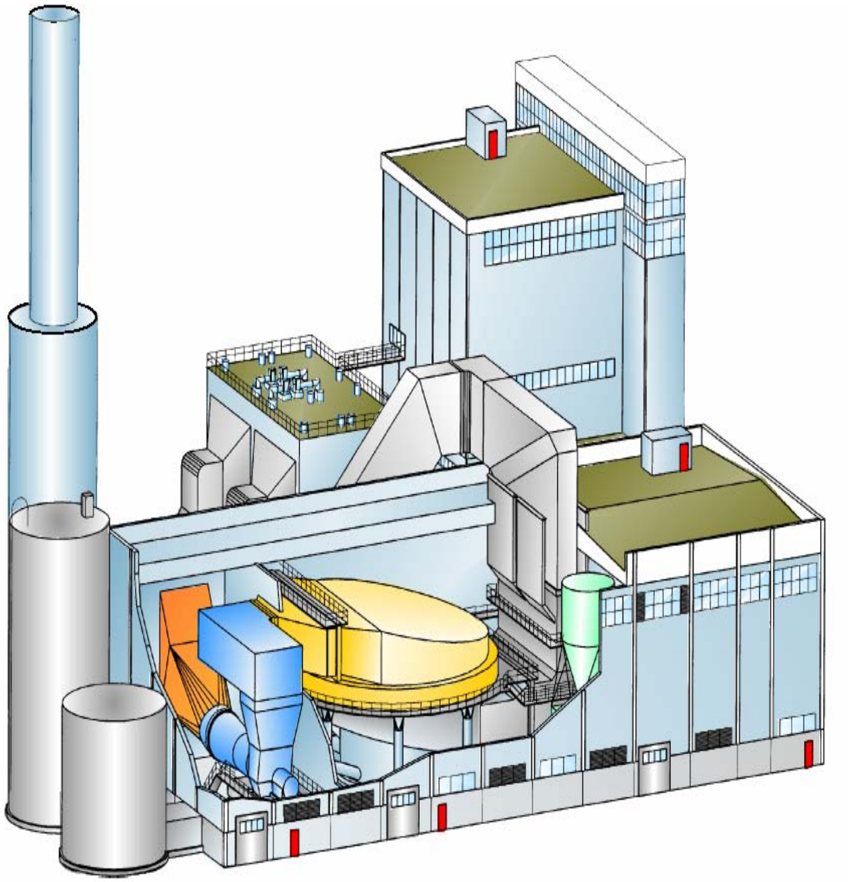
Why ALSTOM?

ALSTOM

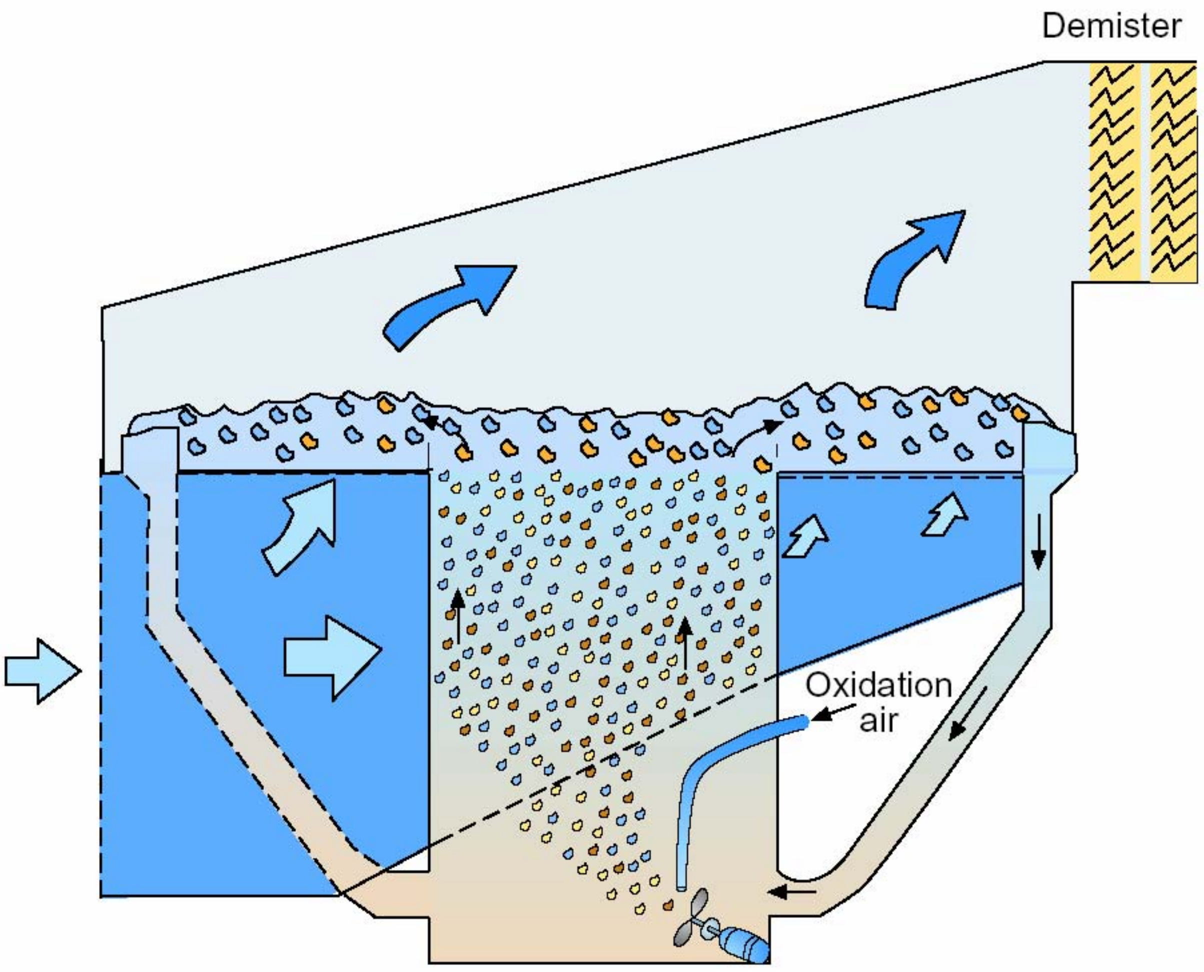
- A diverse portfolio of proven FGD technologies
  – Wet Flue Gas Desulfurization
  – SDA Dry Flue Gas Desulfurization
  – NID Dry Flue Gas Desulfurization
  – Seawater FGD
- Numerous and recent references in all technologies with over 55,000 MW of FGD installations
- Experience over a wide range of site and process conditions
- FGD personnel and offices located around the world with both FGD and large project capability

Karlshamn Full Scale Experience

- ✓ Start-up: November 1996
- ✓ 340 MW Flowpac WFGD
- ✓ Patent Owner: Alstom



No Recycle Pumps



Energy from oxidation blower and fan used in place of recycle pumps.

Flowpac Advantages

ALSTOM

- 97-98% SO_2 collecting efficiency with high sulfur content. Excellent reagent utilization.
- 70% SO_3 removal and high particle collecting efficiency
- No scaling or corrosion problems
- **Lower maintenance** and supervision costs due to low overall height and absence of slurry pumps, absorber headers, and nozzles

Karlshamn - Sweden

ALSTOM

www.alstom.com