Environmental Compliance Solutions in the Age of Air Toxics and CSAP Rules

McIlvaine Hot Hour

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POWER | ALSTOM

Agenda

Overview of Air Toxics Rule

Solution Portfolio to Address Regulatory Requirements

Utility Overall Compliance Strategy

Conclusions

Air Toxics Rule

- The following standards have been proposed for coal-fired EGUs based on emissions achieved by the average of the top 12% best controlled sources (existing) and best comparable single source (new):

Proposed Emission Values for Units Designed for Coal ≥ 8,300 Btu/lb				
Pollutant	**Existing (US)**	**Existing (Metric) – Approx.***	**New (US)**	**New (Metric) – Approx.***
HCl	0.0020 lb/MMBtu or 0.20 lb/MWh	~ 3 mg/Nm3 or ~ 3.5 mg/Nm3	0.30 lb/GWh	~ 0.05 mg/Nm3
SO2	0.20 lb/MMBtu or 2 lb/MWh	~ 350 mg/Nm3	0.40 lb/MWh	~ 65 mg/Nm3
Total PM	0.030 lb/MMBtu or 0.30 lb/MWh	~ 45 mg/Nm3 or ~ 50 mg/Nm3	0.050 lb/MWh	~ 8 mg/Nm3
Hg	1.2 lb/TBtu or 0.008 lb/GWh	~ 1.8 µg/Nm3	0.000010 lb/GWh	~ 0.18 µg/Nm3
Proposed Emission Values for Units Designed for Coal < 8,300 Btu/lb				
Pollutant	**Existing (US)**	**Existing (Metric) – Approx.***	**New (US)**	**New (Metric) – Approx.***
HCl	0.0020 lb/MMBtu or 0.20 lb/MWh	~ 3 mg/Nm3 or ~ 3.5 mg/Nm3	0.30 lb/GWh	~ 0.05 mg/Nm3
SO2	0.20 lb/MMBtu or 2 lb/MWh	~ 350 mg/Nm3	0.40 lb/MWh	~ 65 mg/Nm3
Total PM	0.030 lb/MMBtu or 0.30 lb/MWh	~ 45 mg/Nm3 or ~ 50 mg/Nm3	0.050 lb/MWh	~ 8 mg/Nm3
Hg	4.0 lb/TBtu or 0.040 lb/GWh	~ 6 µg/Nm3 or ~ 75 µg/Nm3	0.040 lb/GWh	~ 75 µg/Nm3
** Conversion to metric values by Alstom. Assumes coal heat values of 8,500 Btu/kW or 8.5 MBtu/MW or 0.0085 TBtu/GW*				

Extremely Low Emission Limits for New Plants

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Solution Portfolio to Address Regulatory Requirements

MERCURY CONTROL

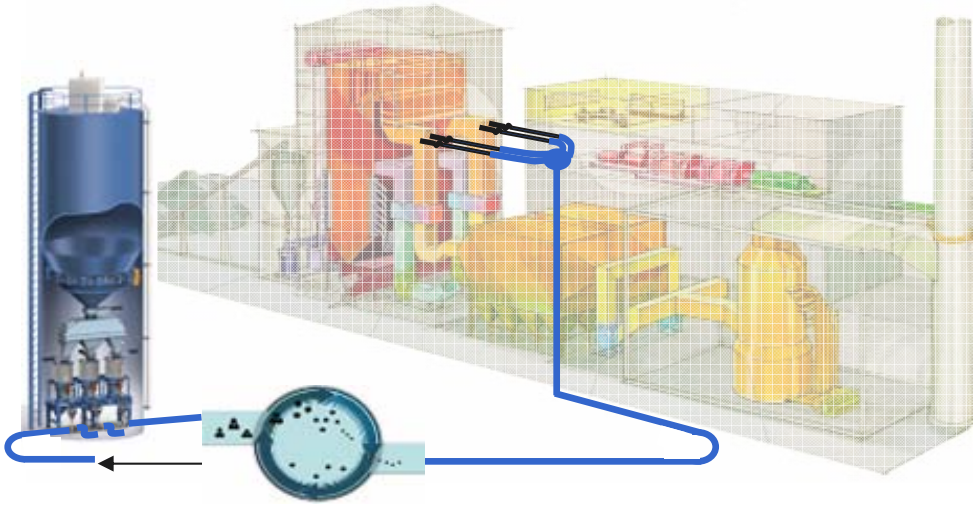
Alstom Mercury Control Technologies

- No “one-size-fits-all” solution for mercury control
  - Each plant has its own unique opportunities/challenges
  - Fuel type, boiler operation, and backend configuration
  - Fit within current / future regulations

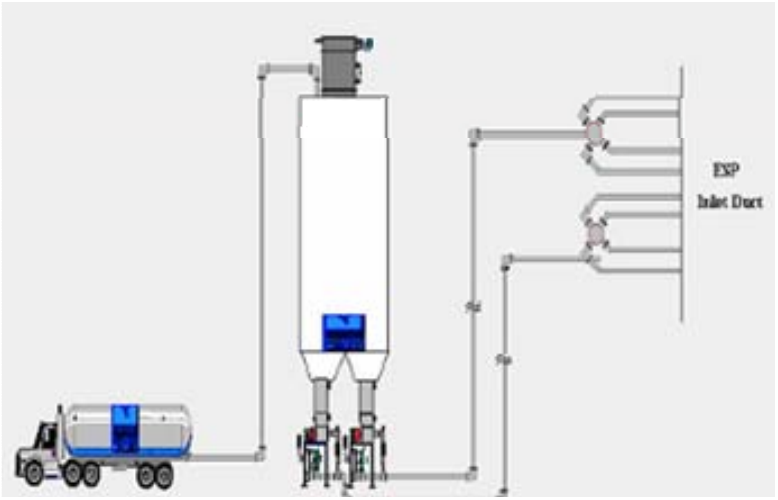
- Alstom has developed diverse mercury control options in order to meet unique challenges of customers
  - Coal additive for Hg oxidation: KNX™
  - Activated Carbon Injection (ACI) + Baghouse Installation: Filsorption
  - “Enhanced” sorbent injection: Mer-Cure™

Alstom Hg control tools work stand-alone and combined

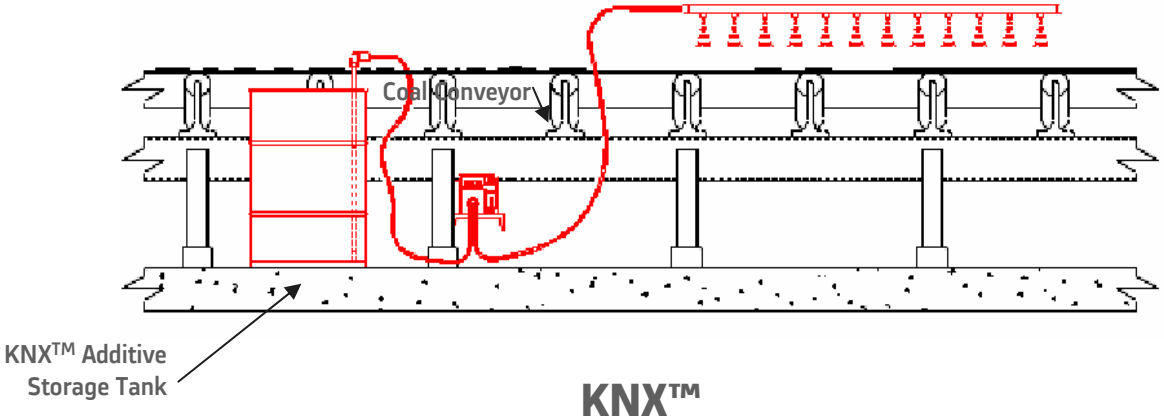
Alstom Mercury Control Technologies



Mer-Cure™



Filsorption



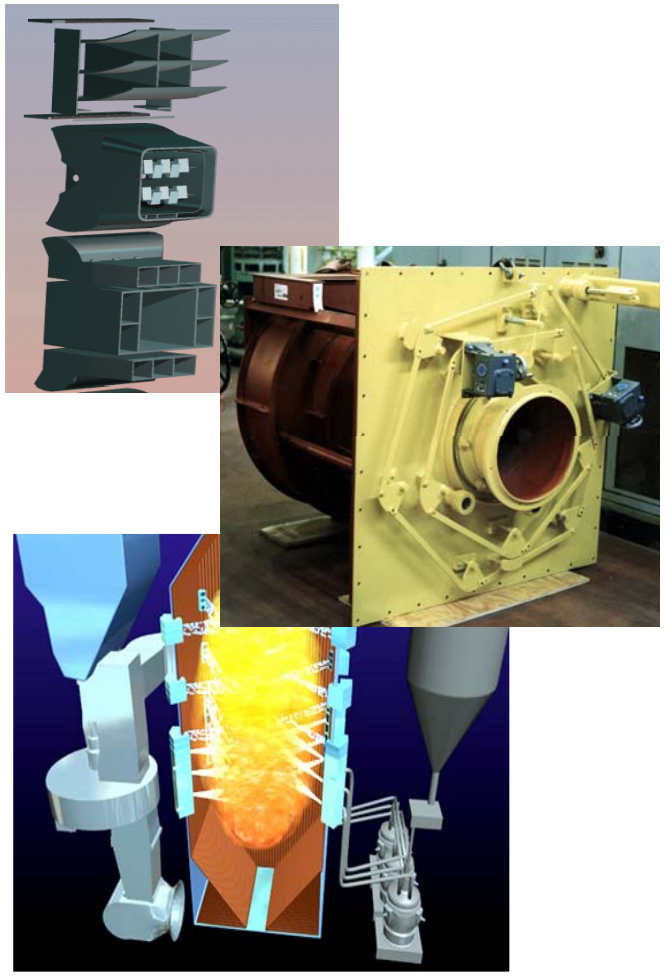
KNX™

Solution Portfolio to Address Regulatory Requirements

NOx CONTROL

Low NOx Burner Experience

Firing System	Units	MWe
LNCFS™ - P2	40	5,406
LNCFS™ Level I	40	11,245
LNCFS™ Level II	67	18,100
LNCFS™ Level III	78	35,327
TFS 2000R™	29	12,535
Cyclones OFA	2	508
Oil/Gas OFA	31	11,243
Other T fired	11	2,844
RSFC™ / Wall Firing	41	5,155



339 Units and 102,363 MWe of Low Nox Burner experience

SCR DeNOx

SCR Features and Advantages:

- NOx reduction efficiency over 90%
- Fuel Types
  - Coal, Oil, Gas
  - Waste to Energy
  - Sludge, Bio Fuel
- Broad SCR Design Experience
  - High, Medium, Low Dust
  - Tail End
  - > 30,000 MW in operation
- Catalyst Experience
  - Design Experience with many worldwide suppliers
  - Ongoing testing of Catalyst Designs

SCR provides DeNOx in diverse spectrum of applications

SO_2 / HCl CONTROL

–

Wet Flue Gas Desulfurization

Limestone WFGD

WFGD Features and Advantages:

- Over 32,000 MW of experience
- SO_2 Removal efficiencies greater than 98%
- Availability greater than 98%
- Experience with high sulfur fuels (4.5% S; >5,000 ppm SO_2)
- Byproduct gypsum (sale or landfill)

Orlando Utilities Commission
Stanton Units 1&2 - 2 x 465 MW
Orlando, Florida

WFGD Remains Solution of Choice for Ultra-High SO_2 Removal

Solution Portfolio to Address Regulatory Requirements

ALSTOM

SO_2 / HCl CONTROL

–

Dry Flue Gas Desulfurization

Spray Dryer Absorber (SDA) FGD

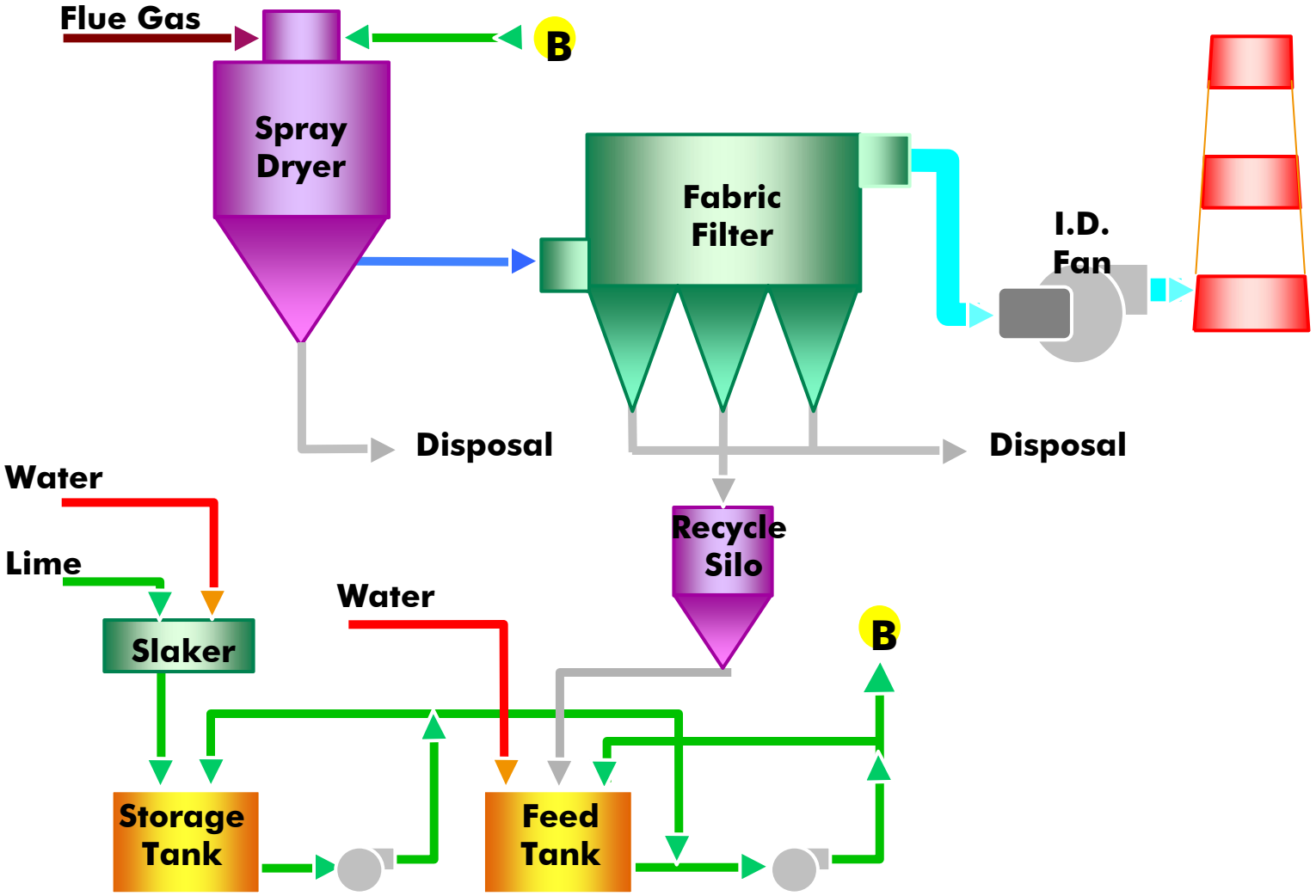
SDA Features and Advantages:

- Over 13,000 MW operating
- First 440 MW DFGD installed 1978
- Boiler Units from 10 to 930 MW
- Single or Multiple Reactors
- Over 100 Installations
- Single or Multiple Atomizers
- SO2 Removal Efficiencies - 95%

GRDA Unit 2 Generating Station
1 x 520 MW DFGD
Pryor, Oklahoma

SDA is proven technology with extensive reference list

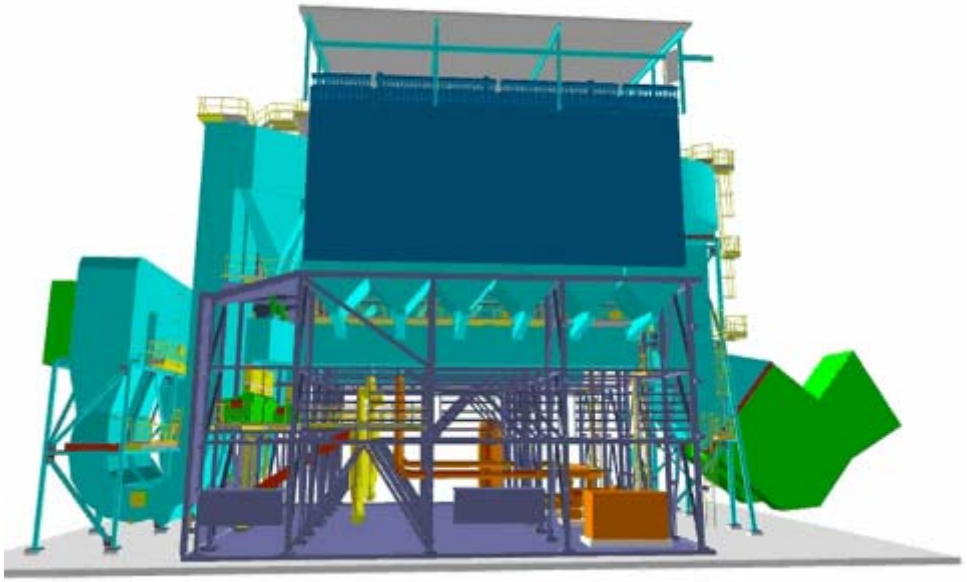
SDA FGD Process Flow



NID FGD

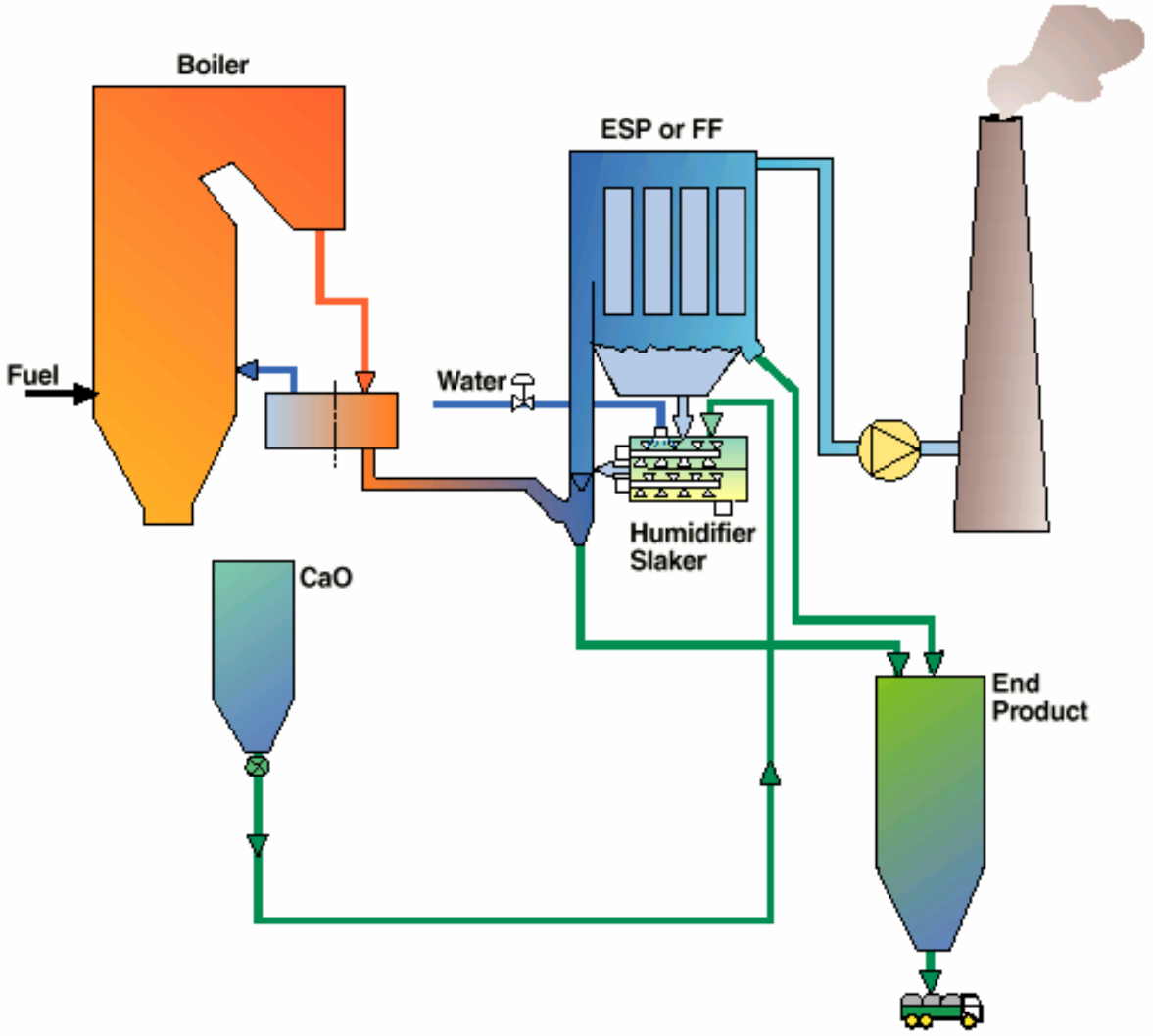
NID Features and Advantages:

- Over 6,000 MW operating
- Over 1,000 MW under construction
- First 120 MW NID installed 1996
- Boiler Units from 10 to 600 MW
- Modular Design
- Over 70 Installations
- Installed Spare Capacity
- SO2 Removal Efficiencies - 98%
- 2.5% Sulfur fuels and higher



NID offers modularization and reduced footprint

NID FGD Flowsheet



Key Benefits of NID FGD

- Multi-pollutant control: High efficiency removal of SO2, SO3, PM, HCl, and HF
  - SO_2 removal: ≤ 98%
  - SO_3 emissions: < 1 ppm
  - PM (filterable): < 0.012 lb/MBtu or 15 mg / Nm^3
- Lime-based semi-dry FGD technology
  - Patented, integrated hydrator/mixer – no slurry handling
  - Zero liquid discharge
  - Low water consumption; ability to use low quality water: CTB, WFGD purge
- Simple, compact design
  - Small footprint offers retrofit advantage
  - Low capital cost
  - Low BOP/construction cost
  - Low O&M cost
- Modular design
  - High reliability
  - Excellent turndown
  - No scale-up issues
- Fuel flexibility of up to 2.5% sulphur coal or higher

Meeting most stringent regulations at minimized cost

Solution Portfolio to Address Regulatory Requirements

PARTICULATE CONTROL

Fabric Filter Systems

Public Service Company, Colorado
Pawnee Station, Unit 1, 550 MW

Alstom FF Advantages and Features:

- Meets the latest world standards for particulate emissions control
- Reverse Gas Design (RGFF)
  - ✓ Reverse Gas with Sonic Horn Assist Bag Cleaning System
- High Ratio Design (LKP)
  - ✓ Intermediate Pressure/ Intermediate Volume Bag Cleaning System
  - ✓ High Pressure/Low Volume Bag Cleaning System
- Fabric Filter compartments retrofittable into Electrostatic Precipitator casings
- New or retrofit applications
- Optimized gas and dust distribution to enhance performance and operation
- Over 18,000 MW operating

Alstom FF designs ensure Particulate Matter compliance

PARTICULATE CONTROL

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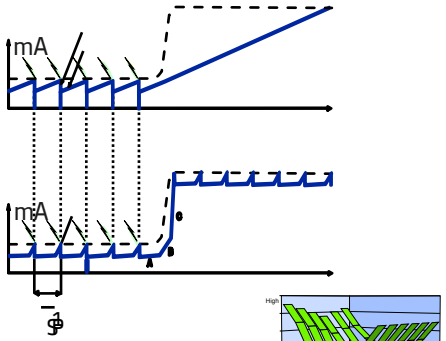
Upgrades and Conversions

PM Control – ESP Products

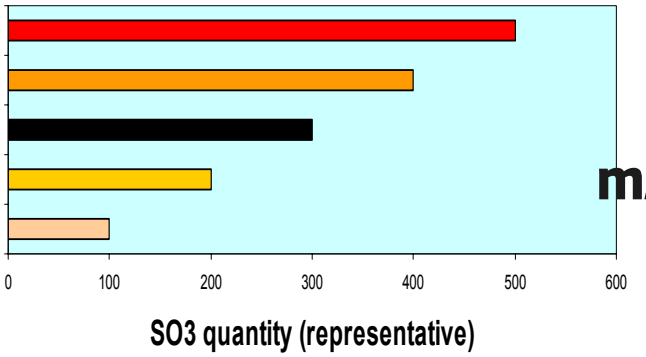


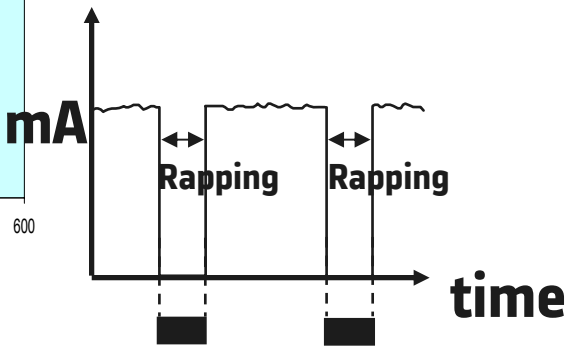
- Spark handling
- EPOQ
- OpOpt
- PCR

Resistivity level
- Very high
- High
- Ok
- Low
- Very low

SULPHIC II

D04
DO3
DO2
DO1

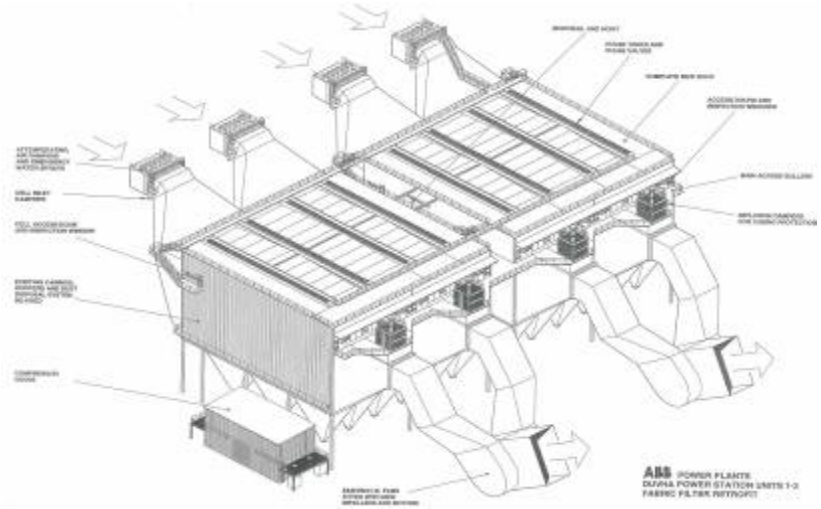




SIR, EPIC, and SULPHIC

PM Control – ESP to FF Conversion

Duvha 3 x 600 MW



Playford: 4 x 60 MW

- 10 upgrades successfully executed globally. Using Alstom Fabric Filter design and products.

Extensive experience in ESP to FF conversions

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NOx Technology Selection

ALSTOM

Space Availability and Permitted Emissions are Critical Key Drivers are……

- Current NOx level
- Unit size, capacity factor, service life
- Existing Burner Design
- Emission limits
  - Percent Reduction
  - Permitted Emissions
- Site issues – Available area
- Other
  - SCR is high cost and high efficiency
  - SNCR and LNB are low cost but low efficiency
  - SCR requires much more space

Direction not always obvious

FGD Technology Selection

Lifecycle cost and reliability are critical.
Key Drivers are……

- Fuel sulfur
- Unit size, capacity factor, service life
- Existing Equipment
- Redundancy
- Emission limits
  - Criteria pollutants
  - Multi-pollutant considerations
- Site issues – Available area
- Other
  - Reagent cost, quality, availability
  - Byproduct sale/disposal
  - Project time available

Direction not always obvious

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- 2011 federal regulations have introduced new limits for a variety of pollutants including SO_2, HCl, NOx, PM, and Hg.
- The key to compliance involves finding the right mix between a host of available and proven technologies.
- The solution of choice will vary by customer – if not by plant – and will be driven by multiple factors including envisioned plant life, existing equipment, performance required, plant layout, capex / opex considerations, schedule.
- The compliance timeline is short. Engage OEMs now to develop the right solution for your specific needs.

ALSTOM's Extensive Technology Portfolio Meets Your Specific Needs

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