Innovations in Environmental Control for Coal Plants

U.S.-Poland Energy Roundtable

Phil Rader
April 24, 2013
Introduction
Three main activities in 4 sectors

Equipment & services for power generation
- Alstom Thermal Power

Equipment & services for power transmission
- Alstom Grid

Equipment & services for rail transport
- Alstom Transport

Alstom Renewable Power
Three main activities in 4 sectors

- **Thermal Power**: 8.7 €bn
- **Grid**: 4 €bn
- **Transport**: 5.2 €bn
- **Renewable Power**: 2 €bn

Total sales 2011/12 = €19.9 billion
Total orders 2011/12 = €21.7 billion
A global footprint

Orders by region and activity in 2011/12

- North America: 12%
- Latin America: 6%
- Africa-Middle East: 13%
- Europe: 44%
- Asia-Pacific: 25%

Thermal Power
Renewable Power
Grid
Transport

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92,800 employees worldwide in 100 countries

By activity

- Thermal Power: 41%
- Renewable Power: 10%
- Corporate: 2.5%
- Grid: 20%
- Transport: 27.5%

By region

- Europe: 58%
- Asia & Pacific: 21%
- Africa & Middle East: 3%
- South America: 8%
- North America: 10%

At end of September 2012

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Balanced Portfolio in Power

Gas

Coal

Oil

Hydro, Ocean, Tidal

Nuclear (turbine island)

Wind on and offshore

Solar

Geothermal

Biomass

Real challenges & realistic solutions

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North American Operations
Knoxville, Tennessee

We are 100% dedicated to design, engineering, procurement and commissioning of air quality control equipment and systems.
Alstom in Poland
Alstom in Poland – Key Data

- 3200 employees in power generation, grid, and transport sectors
- 13.5 MEUR investments in years 2011/2012
- State-of-the-art manufacturing base in Poland
- Poland is a key sourcing country for Alstom
- Alstom’s European excellence center for turbogenerators is located in Wroclaw
- Alstom Konstal supplies railway equipment to major European operators
Alstom in Poland – ECS

- Offices in Warsaw and Lodz
- Staff of 35 supported by 100 individuals in Steam Plant engineering office
- Recently executed projects
  - Janikowo NID for SODA CIECH POLSKA S.A. (2009-2012)
- On-going projects
  - Belchatow ESP for PGE S.A. (2010-2016)
  - Bialystok WTE for Keppel Seghers (2013-2014)
Conventional AQC System

- Electrostatic precipitator with wet flue gas desulfurization is globally dominant technology
- Efficient collection of particulates, SO$_2$, and acid gases
- Limestone reagent; gypsum byproduct
- High capital investment; relatively low operating cost
Alstom NID Technology

- Multi-pollutant control: High efficiency removal of SO$_2$, SO$_3$, PM, HCl, HF, and Hg
  - SO$_2$ removal: up to 98%
  - SO$_3$ emissions: < 1 ppm
  - PM (filterable): < 0.010 lb/MBtu (5 mg/Nm$^3$)
  - HCl: <0.002 lb/MBtu (2 mg/Nm$^3$)
  - Hg: <1.2 lb/Tbtu (1.2 µg/Nm$^3$)

- Lime-based dry FGD technology
  - 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
NID Concept

- Multiple, independently isolatable modules
- Dampers
  - Upstream of reactor
  - Downstream of FF compartment
- Nominal gas flows corresponding to 15 - 90 MW per module
- Can be designed to achieve emissions guarantees at full load with one module out of service
NID Arrangement

- Outlet Plenum
- Fluidizing Trough
- Venturi Duct
- Inlet Plenum
- Fabric Filter
- Reactor
- Mixer/Hydrator

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Elektrownia Power – Laziska Power Plant Units 1 & 2

**Location:** Laziska, Poland

**Application:** PC Boiler

**Fuel:** Coal – 1.4%

**Inlet Loading:** 1400 ppm

**Gas Flow:** 550,000 Nm³/hr

**Commercial:** Unit 1, 1996, Unit 2, 1997

**SO₂:** 95% Removal Measured

**Opacity:** Less than 20%

**Unit size:** 2 x 125 MW

**Reagent:** Lime

**Scope of Supply:** Turnkey supply

**Byproduct:** Landfill
Location: Homer City, PA
Application: Power
Unit size: 2 x 670 MW
Scope: Material supply
Fuel: Bituminous coal
Inlet Loading: Up to 4.5 lb $SO_2$/MMBtu
Gas Flow: 2,630,000 acfm/boiler
Commercial: December 2013
Emissions:
  $SO_2$: 98% removal
  Filterable PM: 0.010 lb/MMBtu
Reagent: Lime
Byproduct: Landfill
Eesti Energia Narva Elektrijaamad AS – Narva

Location: Narva, Estonia
Application: Power
Unit size: 4 x 200 MW
Scope: ESP/FF conversion with NID addition
Fuel: Oil Shale
Inlet Loading: 1.6% S in fuel
Gas Flow: 1,200,000 Nm³/hr per boiler
Emissions:
  \( \text{SO}_2 \): <400 mg/Nm³
  Filterable PM: <50 mg/Nm³
Reagent: Lime
Byproduct: Landfill

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Carbon Capture Technologies

CO₂ capture technologies pursued by Alstom

Post-Combustion
(New + Retrofit)

Oxy-Combustion
(New + Retrofit)

Advanced Amines Process
Chilled Ammonia Process

2nd Generation
Regenerative Calcium Cycle (RCC)

Oxy-Combustion with ASU

Chemical Looping Combustion (CLC)
Advanced Amine Process
Update on Alstom roadmap

Pilot
2007

University of Texas
USA

Industrial / Validation
2009

Dow Chemical Co.
USA - 2 MWth, Coal

2011

EdF Le Havre
France - 5 MWth, Coal

2015-2016

Large-scale demonstration

Moving forward to scale-up the technology

Commercial

Tests completed
In operation
In commissioning/start-up
Targeted

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Chilled Ammonia Process
Update on Alstom roadmap

Roadmap to commercialization

Test Rigs → Industrial Pilots → Validation Pilots → Large-scale demonstration → Commercial

Alstom
Vaxjö Sweden
0.25 MWth

We Energies
Pleasant Prairie
USA - 5 MWth, Coal

EoN Karlshamn
Sweden - 5 MWth, Oil

AEP Mountaineer
USA - 58 MWth, Coal

TCM Mongstad
Norway - 40 MWth, Gas

Getica Turceni
Feasibility
Romania - >250 MWe net, Lignite

CO₂ Capture Mongstad (CCM)
Norway - 280 MWe + 350 MWth, CCPP

Test completed
In Operation
Key Targets

Tests successful
Oxy-Combustion Process
Update on Alstom roadmap

1990’s
R&D and Lab scale

2008
Pilots

Vattenfall
Schwarze Pumpe
Germany - 30 MWth,

Total Lacq
France - 30 MWth,

Alstom BSF
USA - 15 MWth,

2012
Large-scale demonstration

White Rose 426 MWe g - Selby (UK)

Daqing 350 MWe g - Datang (China)

2017/18
Commercial

GPU mobile pilot

In operation
Targeted

Moving forward to scale-up the technology
Particulate Collection

**Electrostatic Precipitators**

- DESP—Dry Electrostatic Precipitator

**Fabric Filters**

- LRFF—Low-Ratio Fabric Filter

- WESP—Wet Electrostatic Precipitator

- HRFF—High-Ratio Fabric Filter
SO$_2$ and Acid Gas Control

Wet Flue Gas Desulfurization

Open Spray Tower

Integrated Emission Control System

Dry Flue Desulfurization

Spray Dry Absorber

NID
NO$_x$ Control

SCR Systems

Combustion Modification

SCR – Selective Catalytic Reduction

Low NO$_x$ Burners
Mercury Control

Option 1
Mer-Cure System

Option 2
PAC System

Option 3
KNX System
Questions?