

REINHOLD ENVIRONMENTAL Ltd.



**2013 APC Round Table
& Expo Presentation**

July 8-9, 2013, in St. Louis, MO / Hosted by Ameren

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Gabriel Pacheco – Acid Gas Product Line Engineer

SDA Dry Scrubber O&M Presented by SIEMENS



Agenda

- Siemens & ESS Overview
- Spray Dryer Absorber (SDA) Technology
- Vertical Ball Miller Slaker O&M
- Ash Conveying System O&M

Sectors and Divisions

Energy

Divisions

- Fossil Power Generation
- Wind Power
- Solar & Hydro
- Oil & Gas
- Energy Service
- Power Transmission



Healthcare

Divisions

- Imaging & Therapy Systems
- Clinical Products
- Diagnostics
- Customer Solutions



Industry

Divisions

- Industry Automation
- Drive Technologies
- Customer Services



Infrastructure & Cities

Divisions

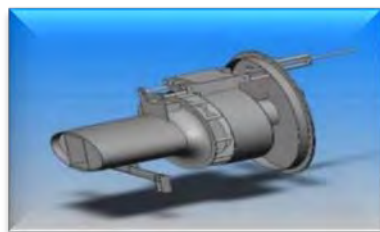
- Rail Systems
- Mobility and Logistics
- Low and Medium Voltage
- Smart Grid
- Building Technologies
- OSRAM ¹⁾



1) In fiscal 2011, Siemens announced its intention to publicly list OSRAM and, as an anchor shareholder, to hold a minority stake in OSRAM AG over the long term

Siemens Environmental Systems & Services

Expanded Products for Changing Markets



- **Flue Gas Desulfurization (FGD)**
 - Dry FGD
 - Mercury Control
 - Wet FGD
- **Electrostatic Precipitators (ESP)**
 - HaRDE
 - VIGR
 - Wet ESP
- **Fabric Filters (FF)**
 - Pulse Jet
 - Cartridge
 - Reverse Air
- **NO_x and Ancillary Products**
 - Low NO_x Burners
 - Overfire Air
 - SNCR
 - SCR (IHI Alliance)
- **Services**
 - Technical Field Services
 - Spare Parts
 - Diversified Services



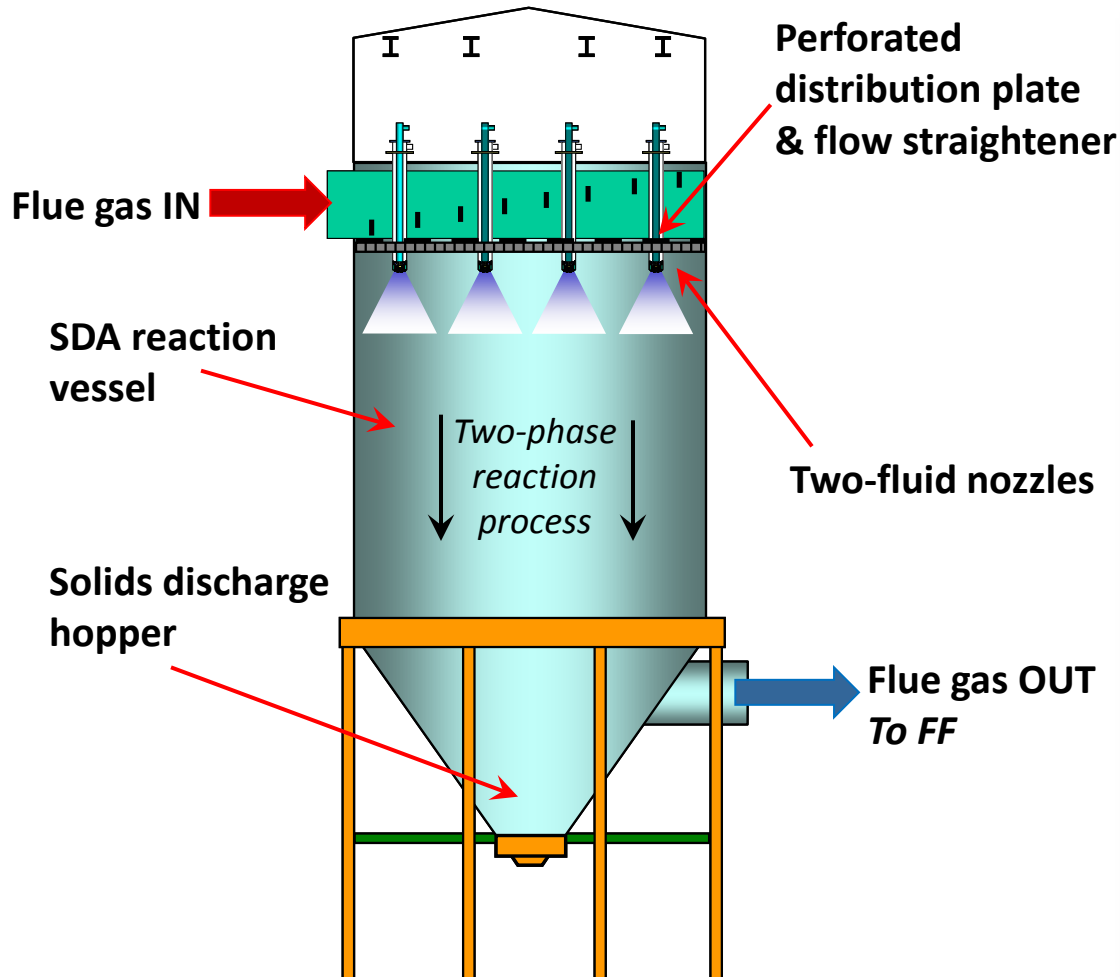
Over 350 Systems & 115,000 MW of Utility Applications

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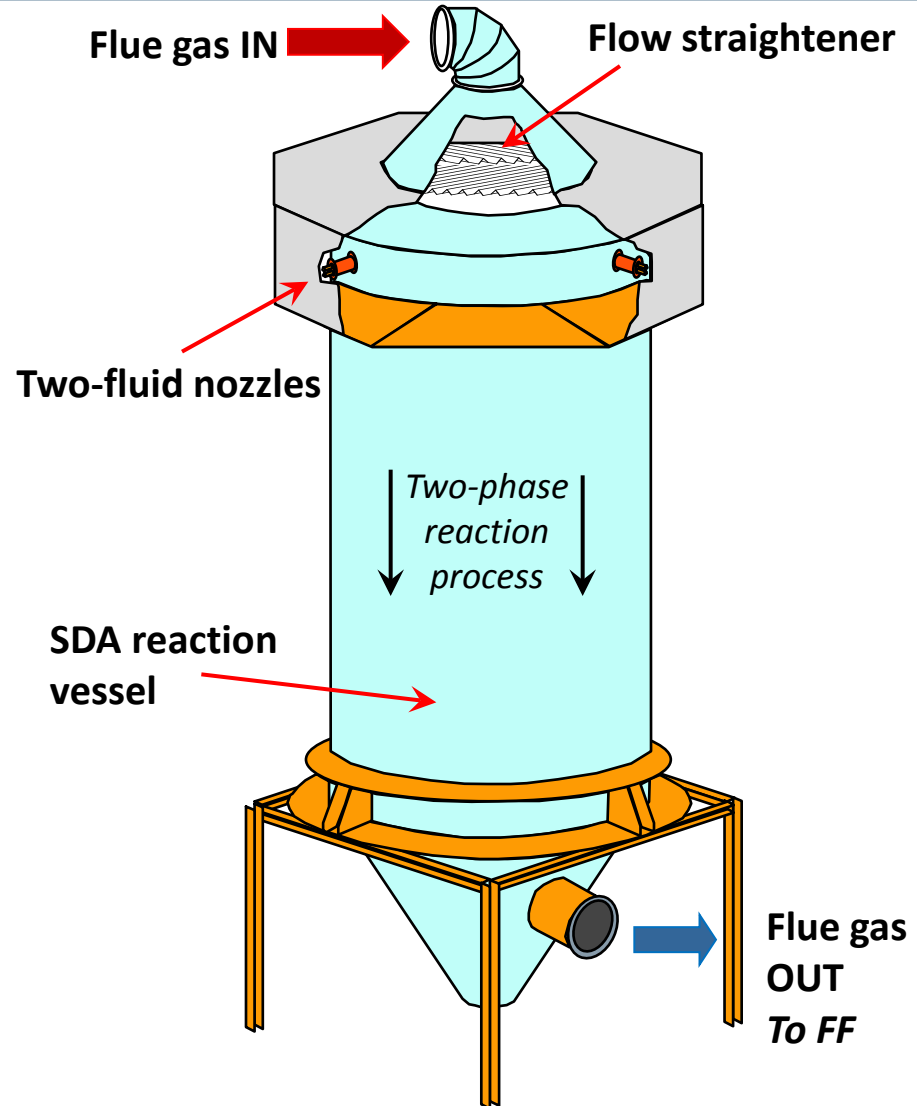
Spray Dryer Absorber (SDA) Technology

Side Entry SDA



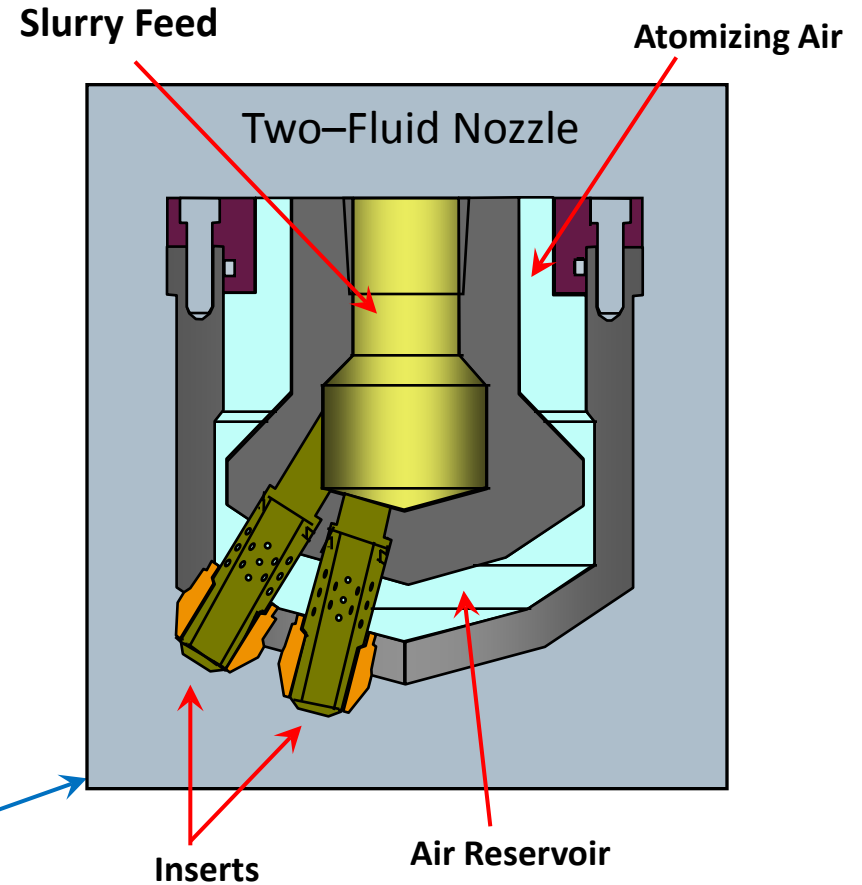
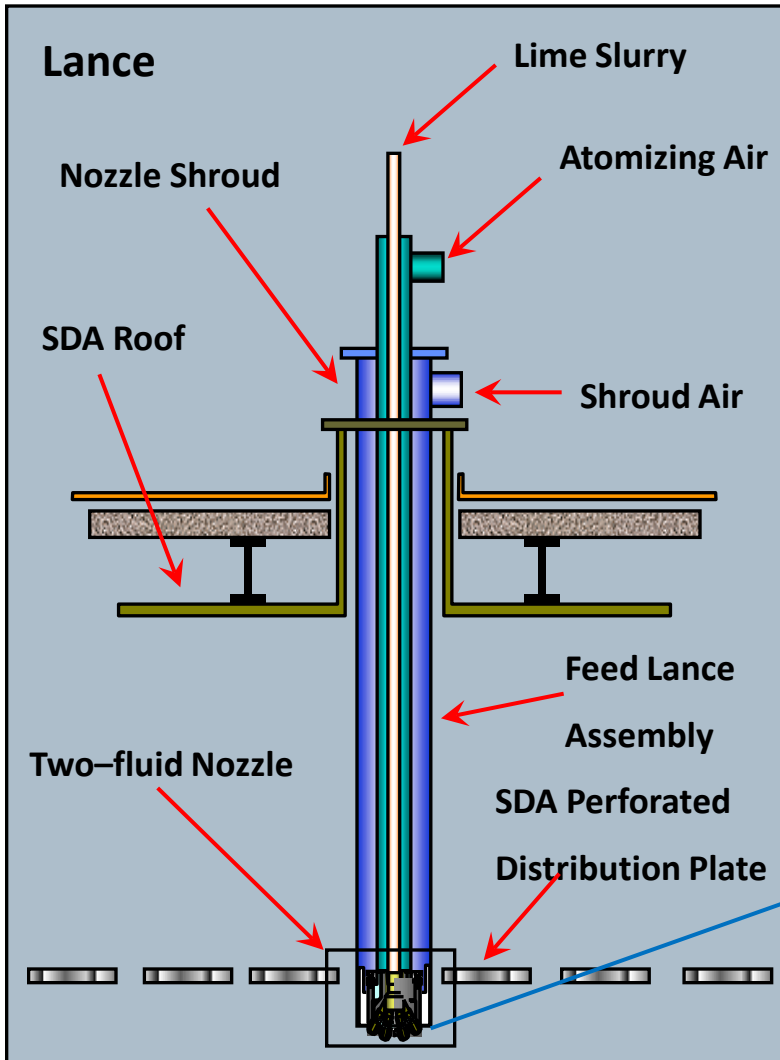
Spray Dryer Absorber (SDA) Technology

Top Entry SDA



Spray Dryer Absorber (SDA) Technology

Nozzle / Lance Assembly



Spray Dryer Absorber (SDA) Technology

2FN Nozzle O&M



Spray Dryer Absorber (SDA) Technology

2FN Nozzle O&M

2-Fluid Nozzle Extraction Procedure:

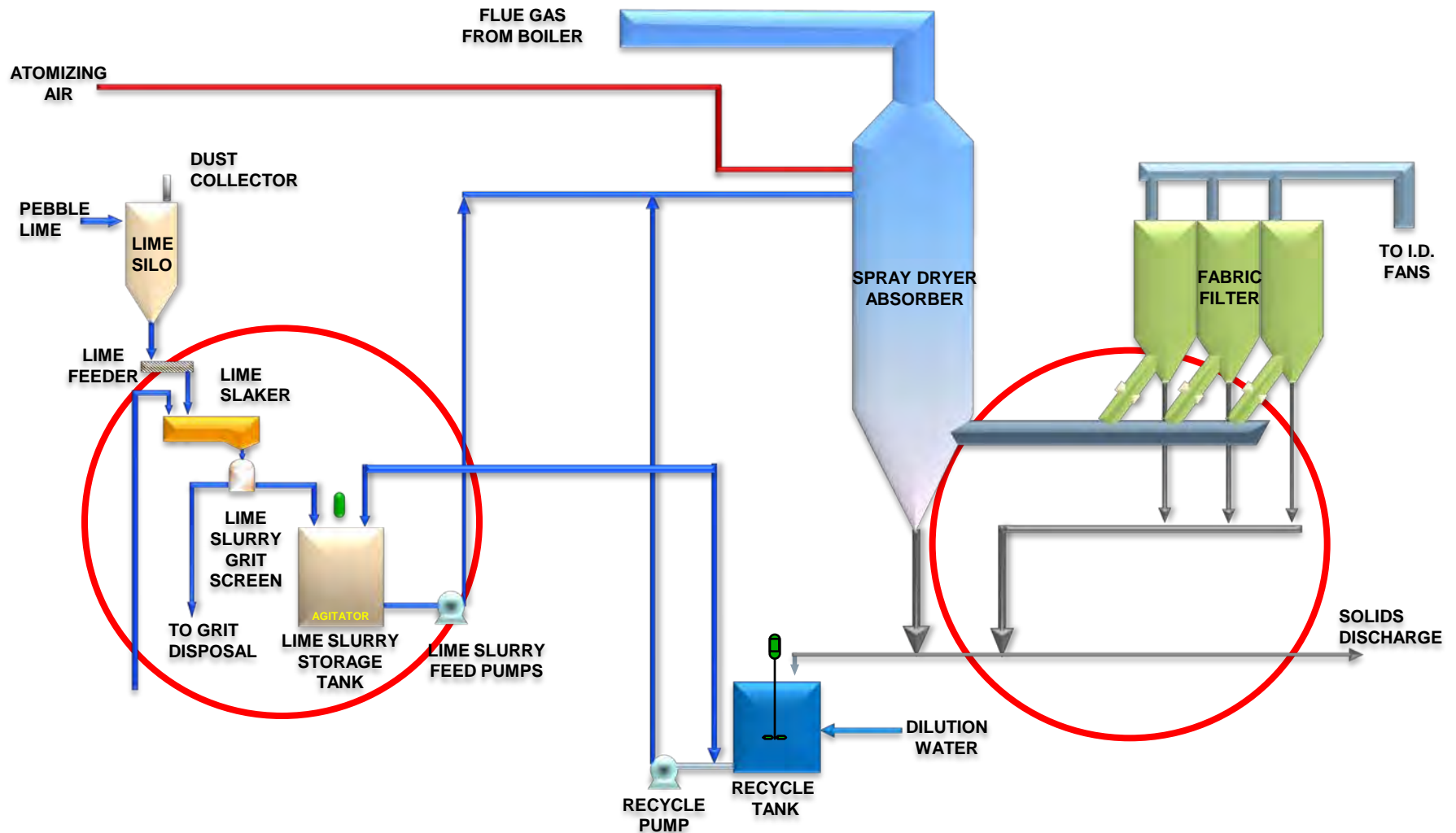
- Done with the system online
- 2 - Fluid nozzle extraction process is simple & safe
- One (1) operator needed
- Does not require lock out tag-out procedure
- 5-10 min process

2-Fluid Nozzle O&M Advantages:

- No wall wetting due to parallel flow design
- No moving parts
- No large mechanical equipment or motors in SDA penthouse area
- No special tools required
- No special operator training

Spray Dryer Absorber (SDA) Technology

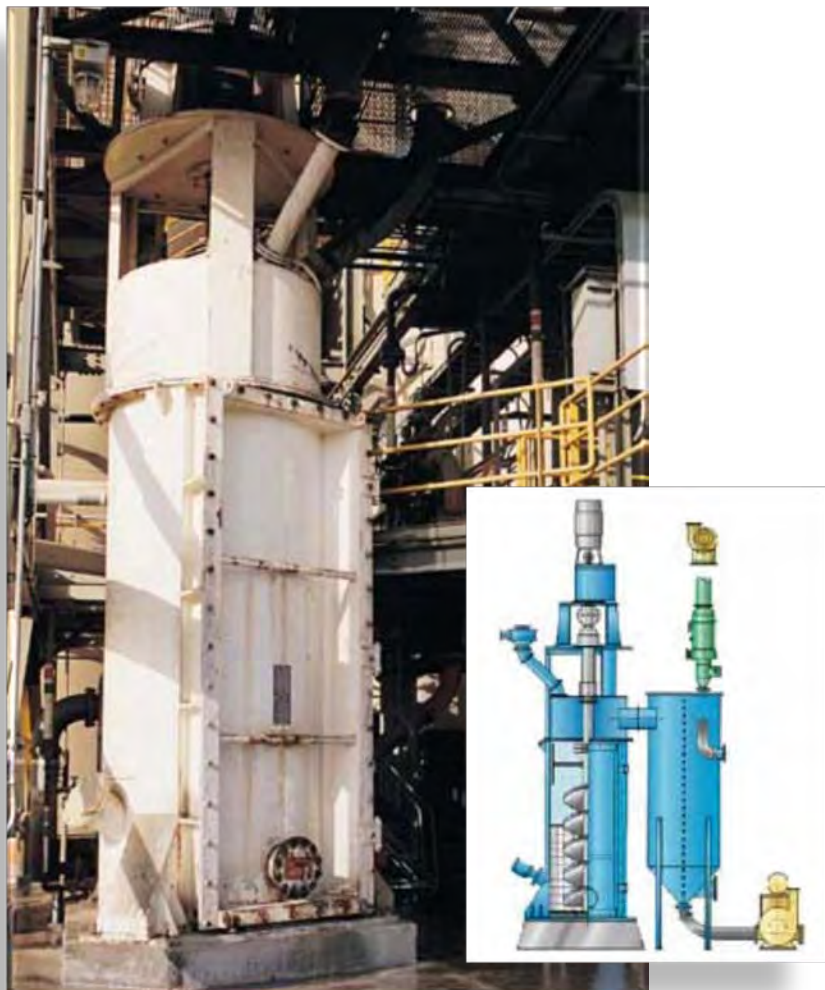
Flow Diagram – Ash Recycle System



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Vertical Ball Mill Slaker O&M



- Vertical Ball Mill used for the grinding of pebble lime [CaO] to create Calcium Hydroxide [Ca(OH)₂] slurry
- Detention, Horizontal, Paste Slakers
- Vertical Ball Mill Slaker advantages:
 - No grit removal required
 - Large Capacity
 - Minimal Maintenance Cost
 - High Retention Time
 - More Highly Fine Reactive Product
- Vertical Ball Mill Slaker disadvantages:
 - Higher Capital Cost
 - Larger footprint

Vertical Ball Mill Slaker O&M

Correct slaking temperature is critical to the scrubbing process as it effects SO₂ removal.

- Errors in operation effect the entire AQCS process
 - Affects lime slurry percent solids and particle size
 - Can lead to an increase in reagent consumption
- Adjustments should be made quickly to maintain the correct slaking temperature
- Errors can take days to mitigate skewing SO₂ rolling averages



Vertical Ball Mill Slaker O&M

Case Study: Low SO₂ removal (~60%) with 1.5 lb/mmBTU SO₂ at the inlet.

Issues Discovered:

- Operation of the Vertical Ball Slaker below design temperature for months
- No adjustments made to lime/water ratio
- No record of screw feeder re-calibration
- Lime Slurry percent solids below design solids
- Lime Slurry appeared dilute and out of specification

Vertical Ball Mill Slaker O&M

Troubleshooting:

1. Ensure correct pebble lime feed:

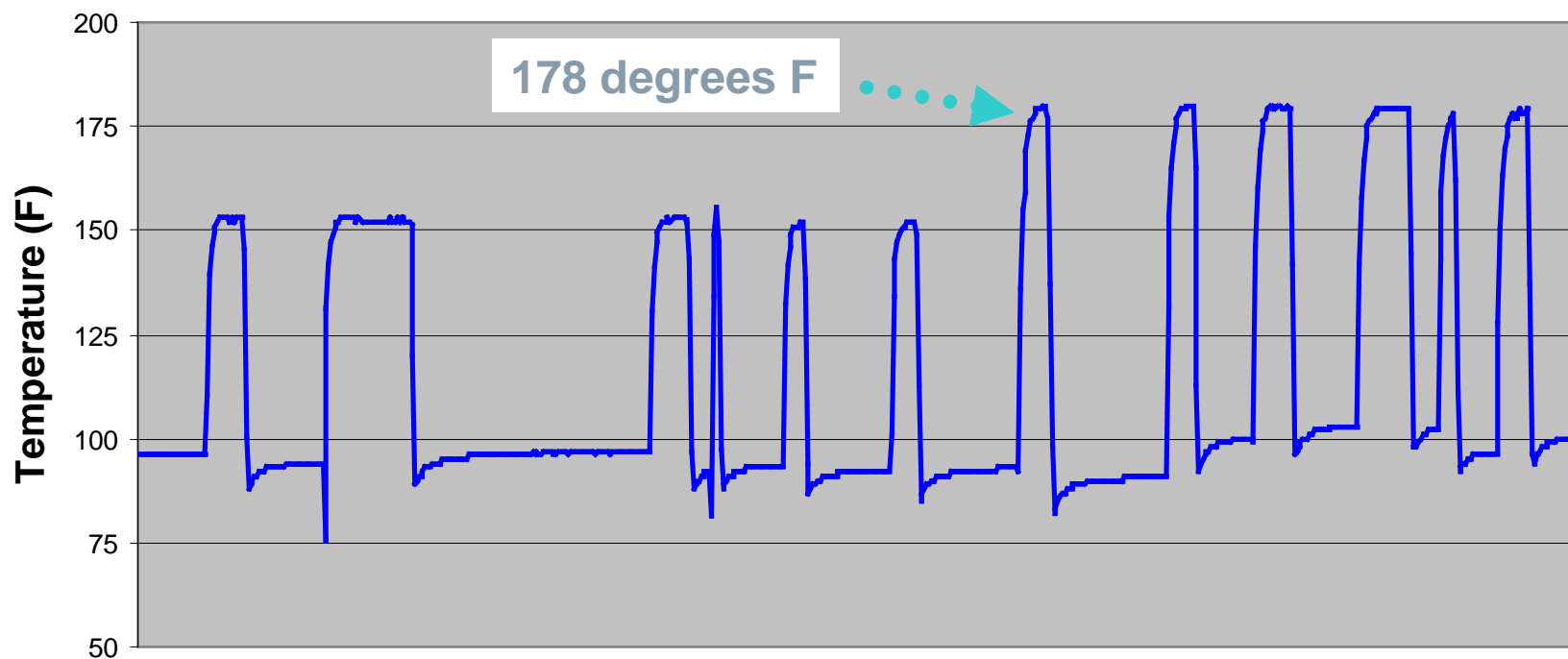
- No O&M record of screw feeder being calibrated
- Calibration weight typically provided with system
- Calibrated the screw feeder to ensure correct material is being measured into the slaker

2. Ensure correct slaking temperature

- Verified correct slaking water temperature and quality
- Verified slaker power draw, indicates amount grinding balls
- Adjusted lime/water ratio by 30%
- Verified correct available lime index

Vertical Ball Mill Slaker O&M

Vertical Ball Mill Slaker Operating Temperature



Vertical Ball Mill Slaker O&M

Results:

1. Improved Slaking Temperature:

- Previous lime/water ratio added more water to the lime slurry than required
- Slaking temperature improved from ~150 degrees F to 178 degrees F (design)

2. Improved Lime Slurry Concentration

- Lime Slurry specific gravity increased from 1.05 to 1.13
- Specific gravity measured in the field was verified in a laboratory
- Particle size verified in a laboratory
- Lime utilization verified

3. Improved SO₂ Removal

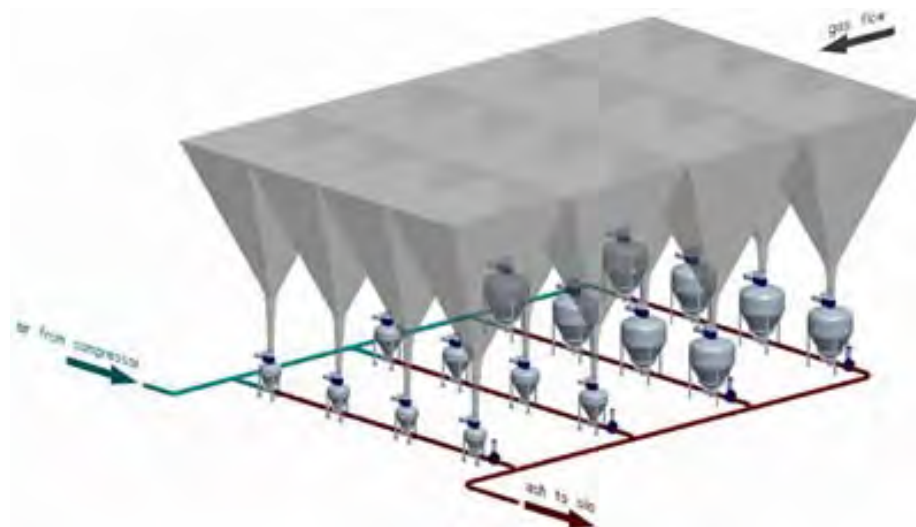
- SO₂ removal improved from 60% to 90%

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Ash Conveying System O&M

- Positive Pressure Ash Conveying System used to transport SDA byproduct from Fabric Filter to Recycle/Disposal Silo
- Vacuum Systems, Belt Conveyors, Drag Chain Conveyors
- Positive Pressure System advantages:
 - Large Capacity
 - Minimal Maintenance Cost
 - Minimal Moving Parts
 - Separators not required
- Positive Pressure System disadvantages:
 - Fabric Filter Elevated
 - Push Forward System



Ash Conveying System O&M

Ash Conveying System is critical to the scrubbing process as it affects SDA performance.

- Issues with the ash conveying system can constrain the entire AQCS system
- High Levels in Fabric Filter Hoppers
- If issues cannot be resolved, adjustments to the SDA need to be made
- Affects SO₂ rolling averages if adjustments need to be made to the SDA system

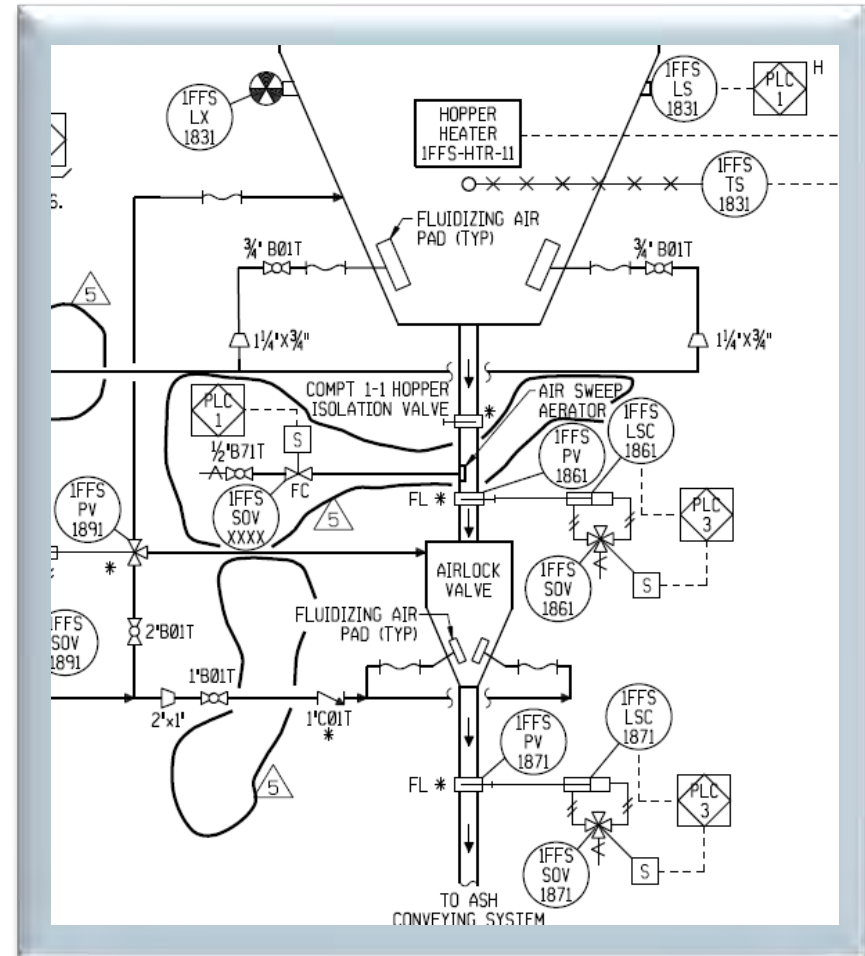


Ash Conveying System O&M

Case Study: Consistent High Levels in the Fabric Filter Hoppers even after compartment isolation or SDA shutdown.

Issues Discovered:

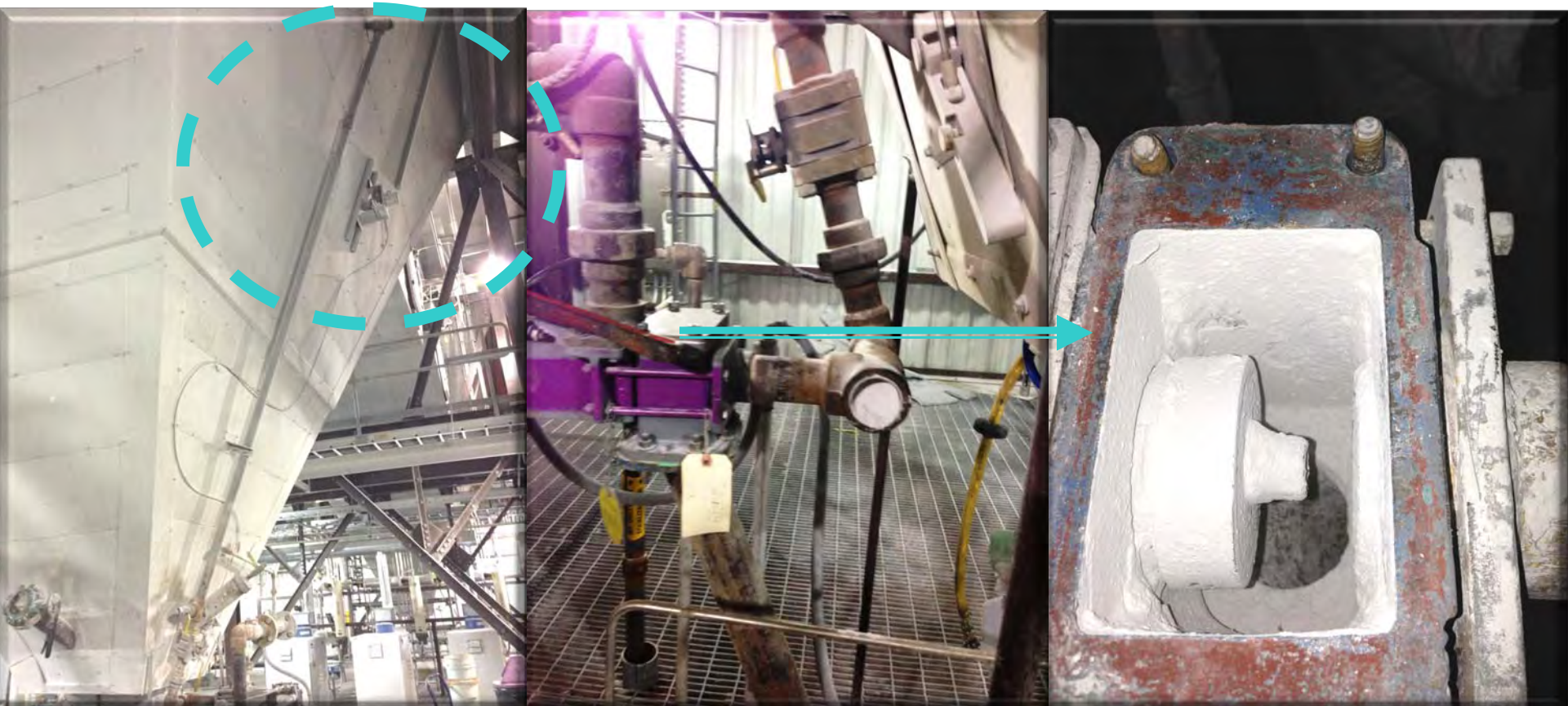
- Continuous operation with hopper Hi Level alarms
- Ash conveying line pressure lower than design conditions
- Incorrect airlock fill time
- Adjustments to SDA were made to reduce ash loading



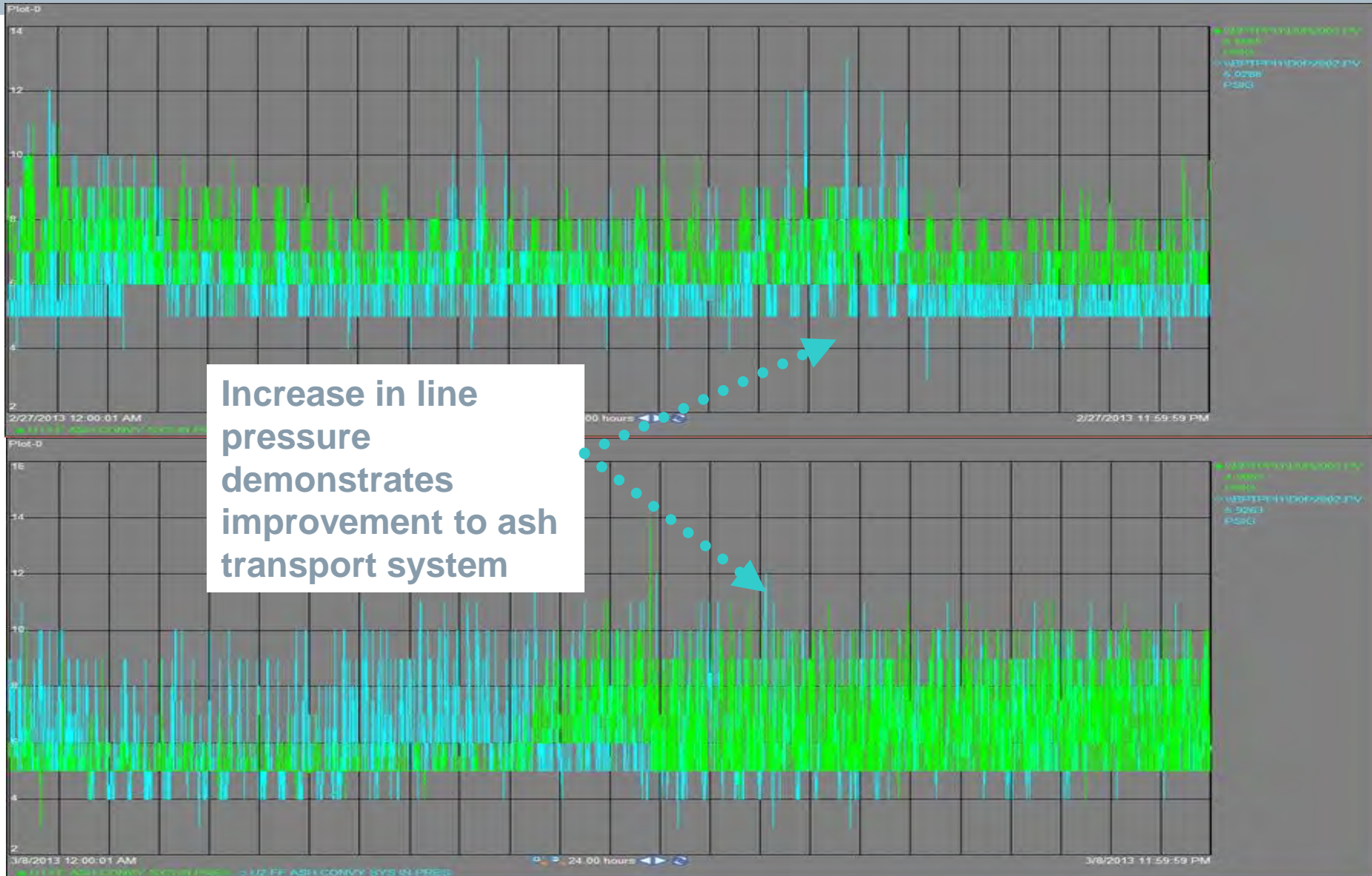
Ash Conveying System O&M

Inspected equalizing air piping:

1. Found evidence of ash in the equalizing air piping



Ash Conveying System O&M



Increase in line pressure demonstrates improvement to ash transport system

Ash Conveying System O&M

Results:

1. Ash Conveying Line Pressure:

- Pressure 2x as much as previously seen

2. Fabric Filter Hi Levels

- Multi-month operation without a hi-level
- Fabric Filter Hoppers are empty
- SOP changed per Siemens recommendations (isolate compartment when a Hi-Level is reached)

3. Improved SO₂ Removal

- System can operate at the design SDA outlet temperature
- Continuous operation without impacting the SO₂ rolling average

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