REINHOLD ENVIRONMENTAL ®

2026 Reinhold/PCUG Round Table Presentation

Hosted by TVA, Southern Company and Vistra

in the Sonesta Nashville Airport Hotel, Nashville, TN

on June 22-23, 2026

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Optimizing Hydrated Lime Use with Mixing Technology in a Dry Sorbent Injection Application

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2026 REINHOLD/PCUG Conference, June 22-23, 2026, Nashville TN
Round-Table, Workshop 10

ONE SOURCE. MANY SOLUTIONS.

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Problem Description

- Prairie State Energy Campus is a 1600 MW coal-fired power plant near St. Louis, MO with two units firing Illinois No 6 coal (mine mouth).
- PSGC uses high reactivity hydrated lime in their dry sorbent injection to control stack SO_3 emission as part of a comprehensive air quality control system.
- Hydrated lime use increased excessively over time based on deliveries.
- The post Air Heater hydrated lime injection lance grid frequently plugged due to small bore (1”) lances that had to pulled and replaced each time.
- PSGC injected pre-SCR, but it was not preferred due to SO_2 and HCl capture at higher temperature affecting the sale of fly ash.
- PSGC upgraded their supply system but had yet to install weigh feeders to directly measure hydrated lime use in either unit.

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Solution

Babcock Power proposed replacing the existing post AH DSI system:

- Install Delta-wing® static mixers to totally disperse hydrated lime.
- Replace the lance grid (16 one inch bore lances per side) with fewer, larger bore lances provided by static mixing.
- Employ vertical supply line splitting to improve hydrated lime distribution to the lances.

After BPI proposal was accepted, Prairie State installed hydrated lime weigh feeders to directly measure how much hydrated lime was being used in each unit.

Using CFD and physical flow models, Babcock Power optimized Delta-wing® static mixers in pre-AH (post SCR) and existing post-AH injection locations for each duplicate Unit.

A Unit 1 post-AH system was installed, and a Unit 2 post-AH system is now being installed due to significantly reduced Unit 1 hydrate lime use.

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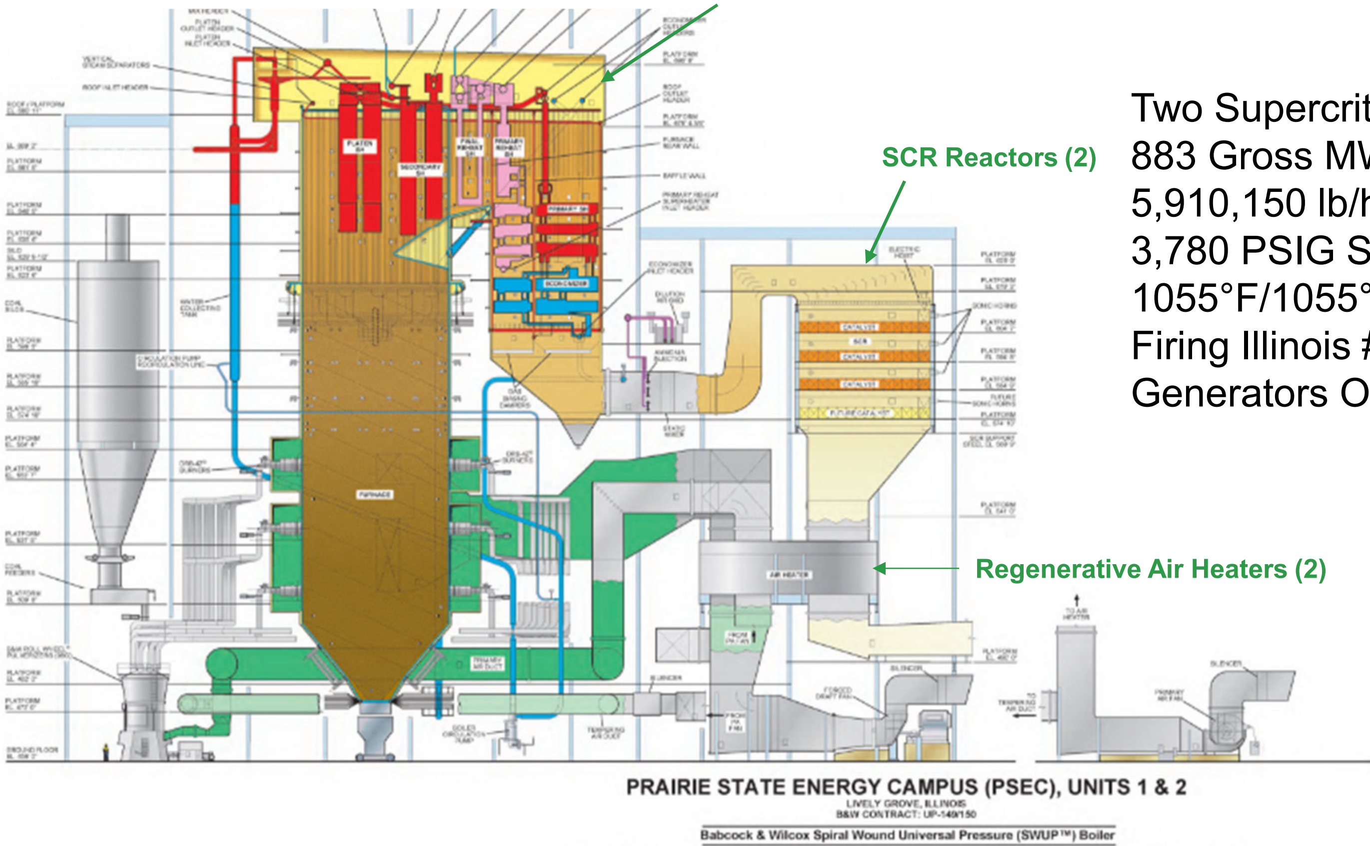
Prairie State Units 1 & 2

Opposed Wall-Fired B&W Supercritical Boiler

SCR Reactors (2)

Regenerative Air Heaters (2)



Two Supercritical Units
883 Gross MW (750 MWe)
5,910,150 lb/h steam
3,780 PSIG Superheater Outlet Pressure
1055°F/1055°F SH/RH Outlet Temperatures
Firing Illinois #6 Coal (Mine Mouth)
Generators On-line in 2012

Prairie State Units 1 & 2
Air Quality Control System

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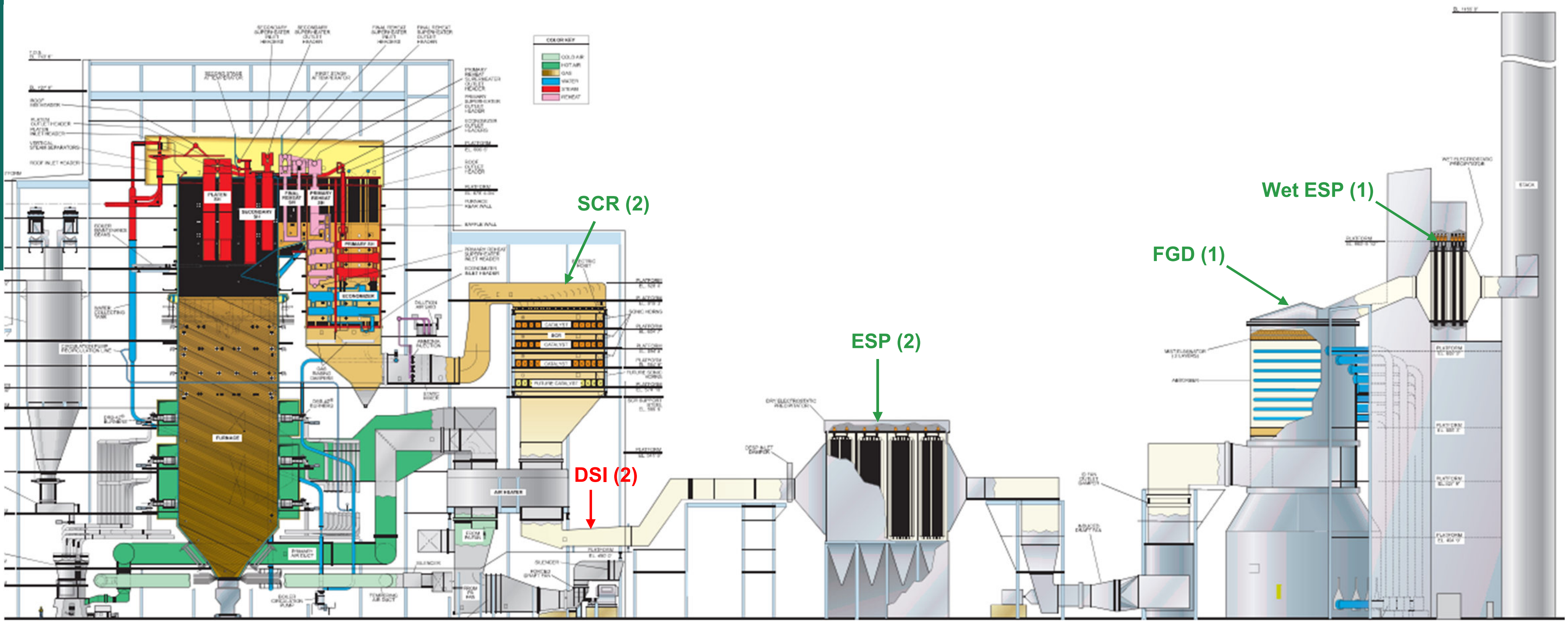

Units 1 & 2 Hydrated Lime Injecting Points to Control SO_3

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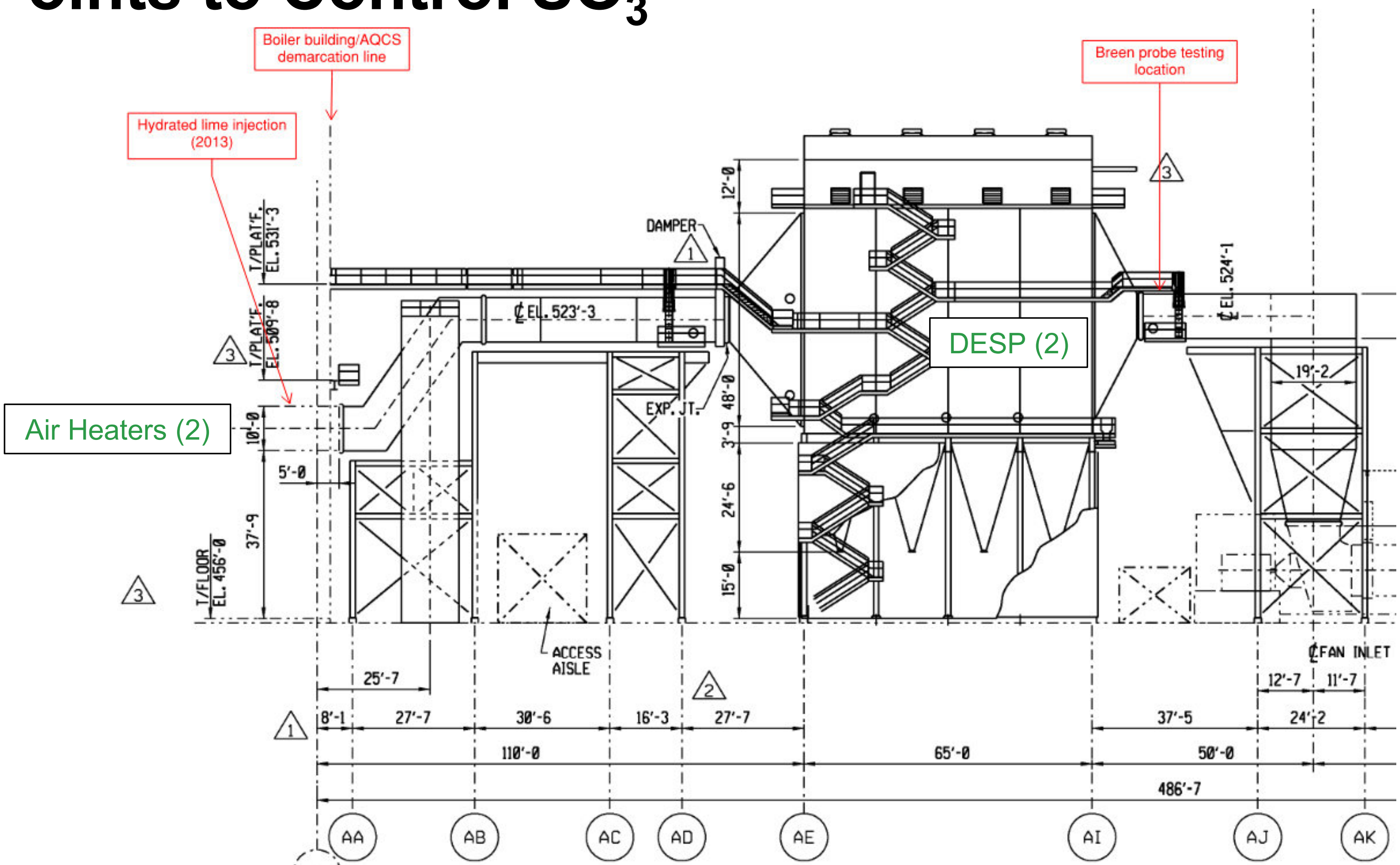

Prairie State Units 1 & 2 Electro-Static Precipitator Arrangement

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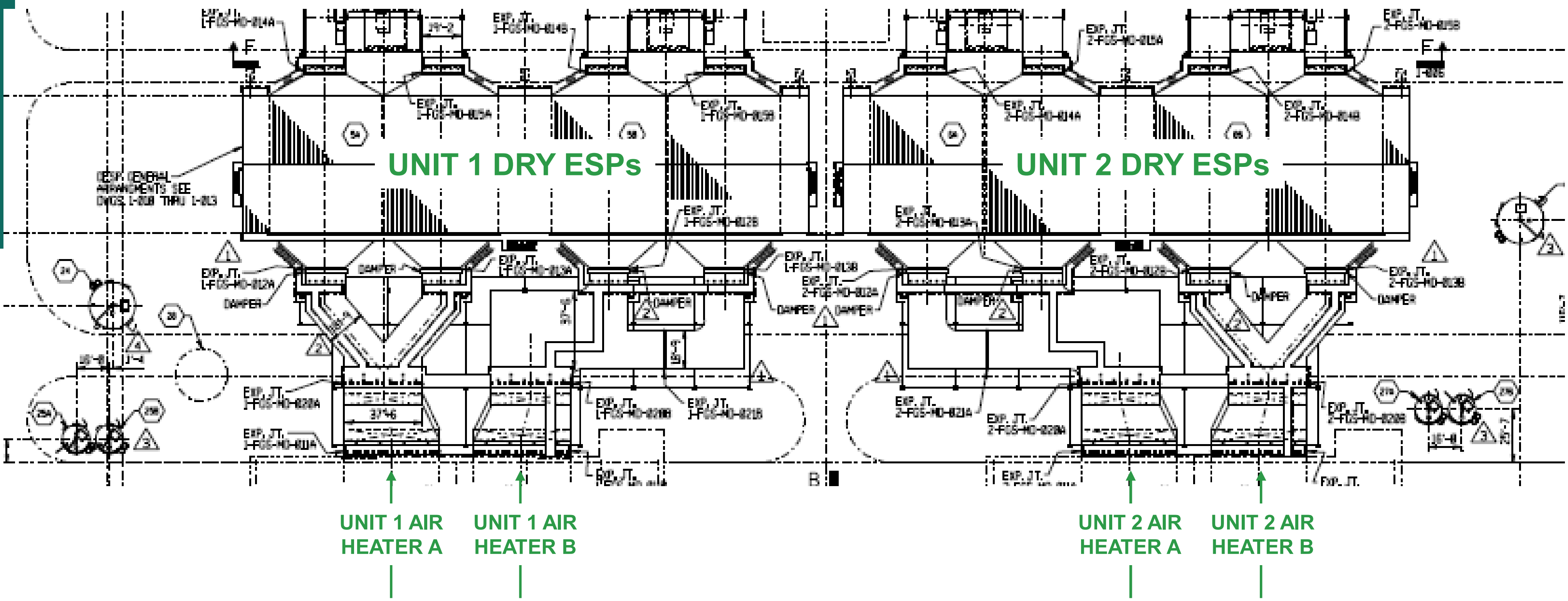

Unit 1 Air Heater Outlet Ducting to ESPs

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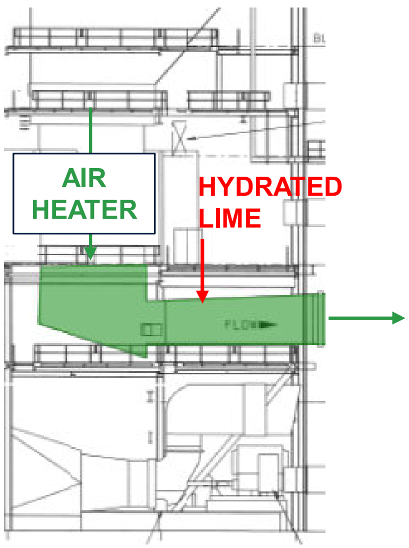
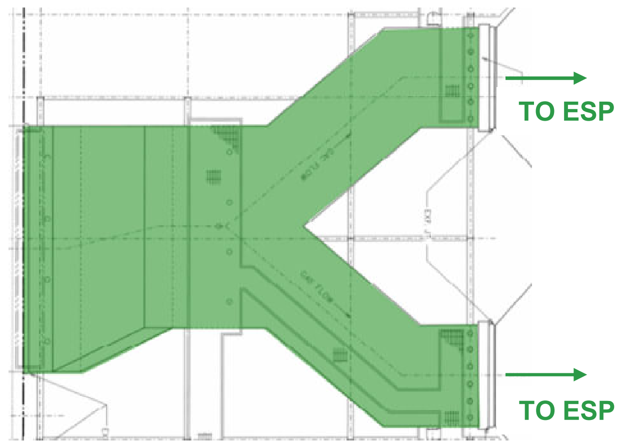
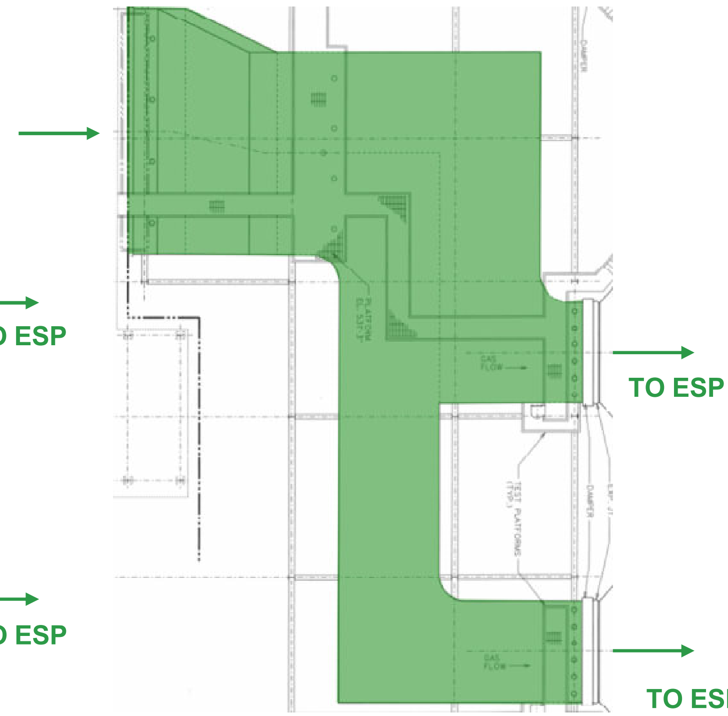


Elevation View



A-Side Plan View



B-Side Plan View

Unit 1 Dry Sorbent Injection P&ID Before Upgrade

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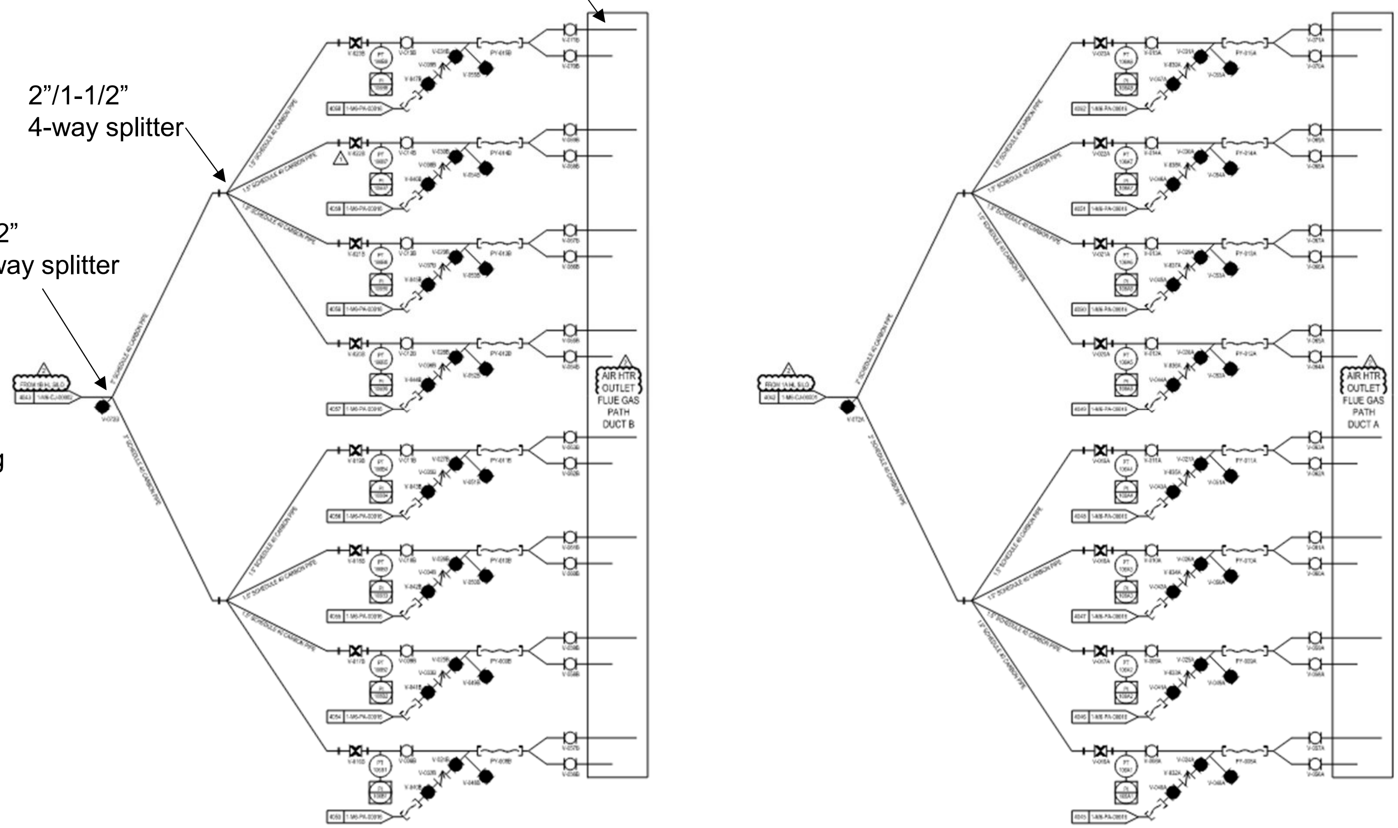
Sixteen 1” lances

Same supply, splitters, and lances on both sides, A & B

2”/1-1/2”
4-way splitter

4”/2”
2-way splitter

4” supply
3000 fpm
conveying
velocity



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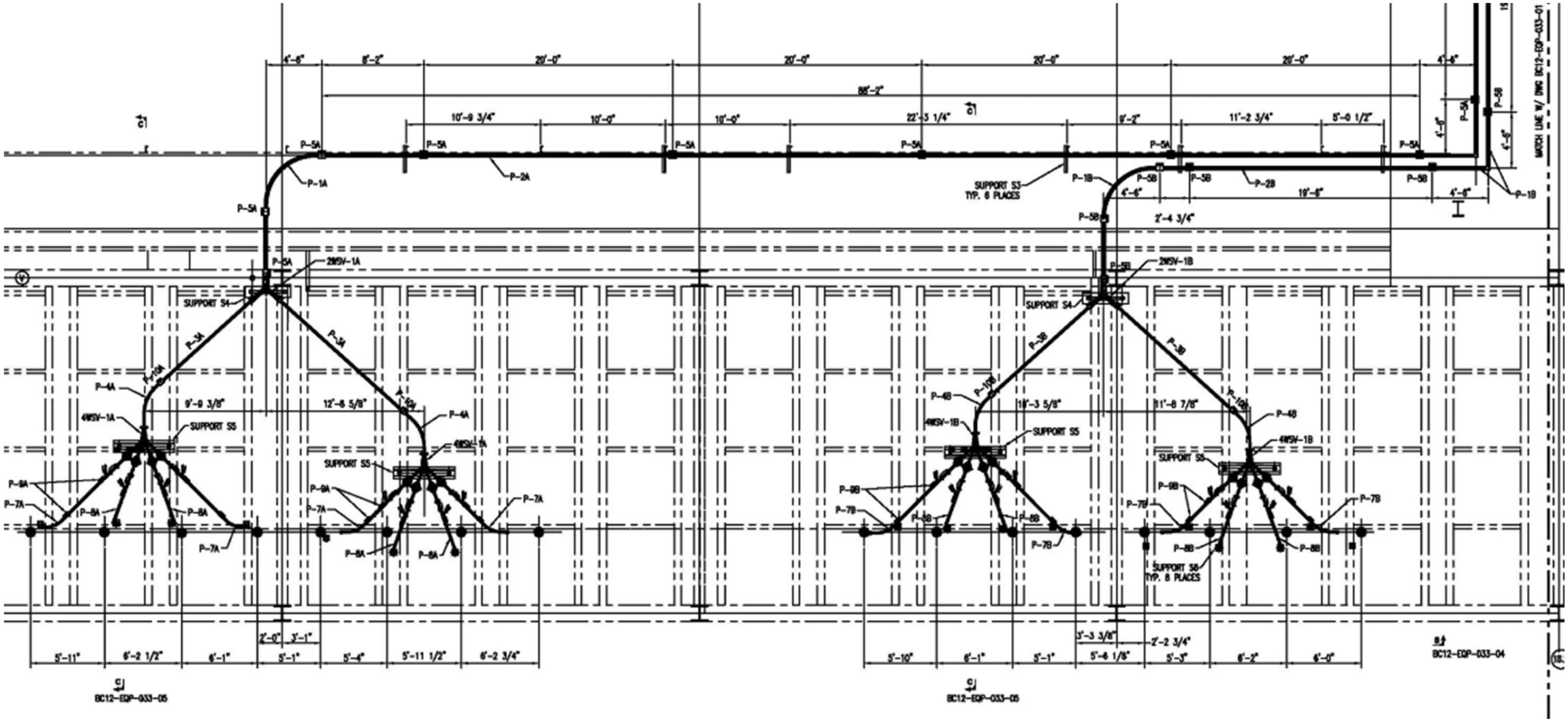
Unit 1 Dry Sorbent Injection Pipe Layout Before Upgrade



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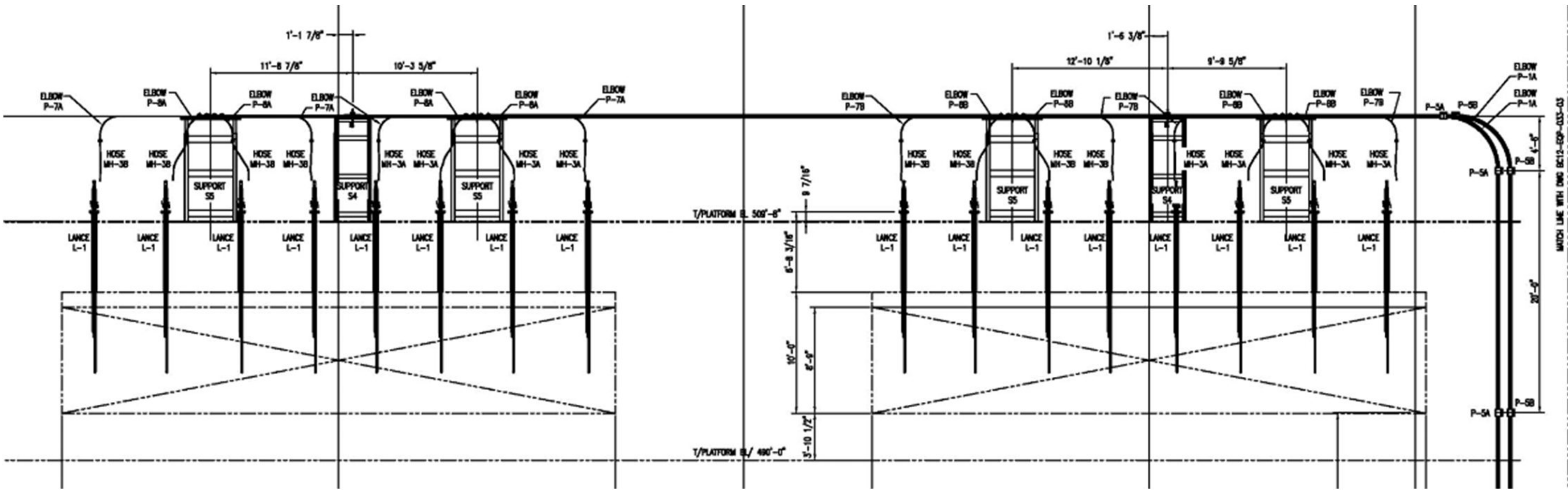
Unit 1 Dry Sorbent Injection Lance Grid Before Upgrade



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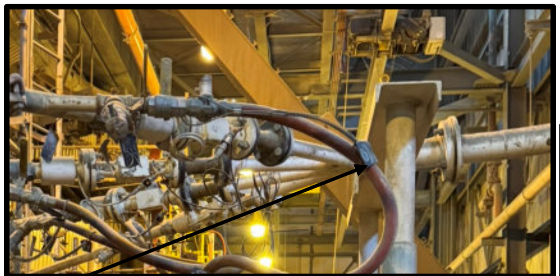
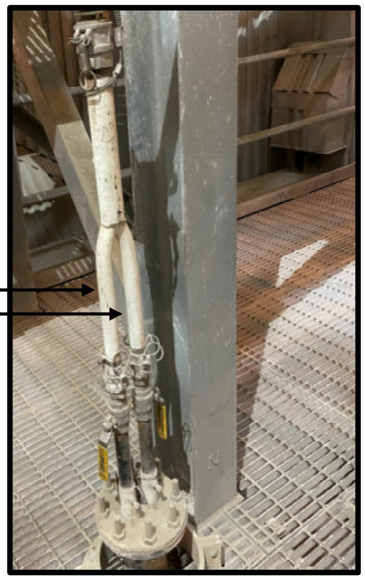
Unit 1 Dry Sorbent Injection System Before Upgrade





4-way horizontal splitter

Sixteen 1” lances per side, A & B

2-way horizontal splitter

New Delta Wing® DSI Project

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Phase	Unit	Description
1	1 & 2	CFD Model
2	1 & 2	Physical Flow Model
3	1	Engineering
4	1	Install and Test
Current	2	Engineering (Duplicate Unit 1)

CFD Model – Lance Grid Before Upgrade

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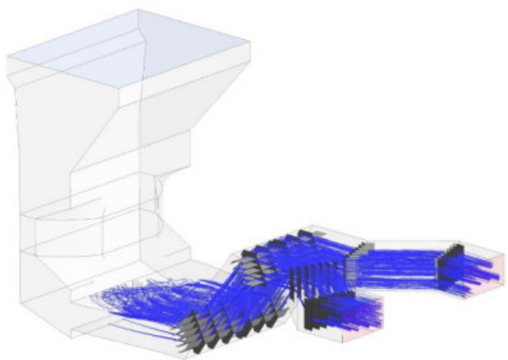
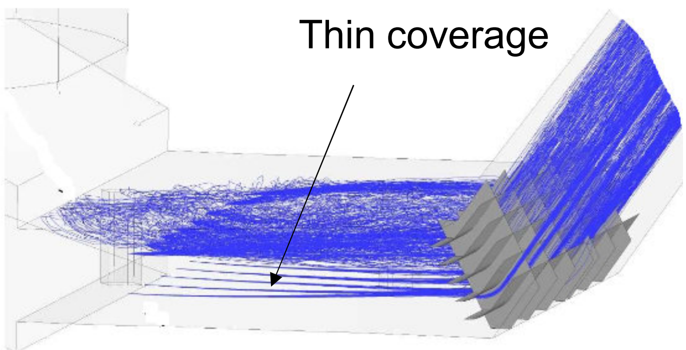
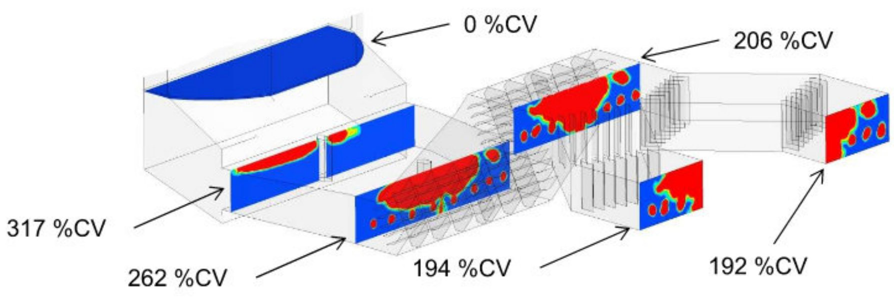


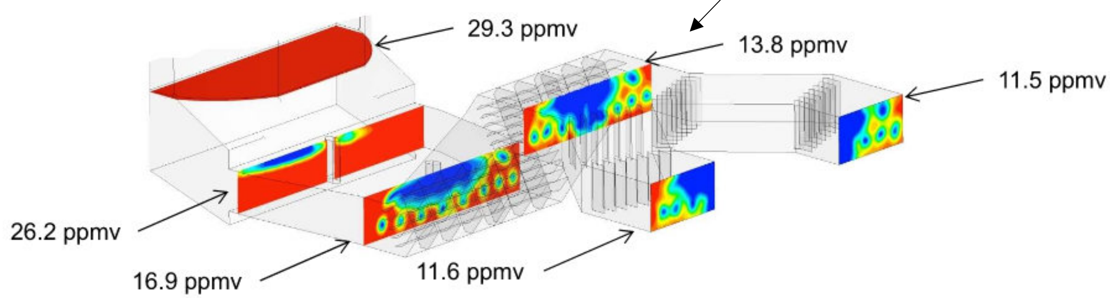


Particle Trajectories

Simulated 2013 DSI Lances Removing 60% SO_3 at 2,200 lb/h hydrated lime injection rate per side (A & B).



Sorbent Variation Coefficient



Calculated SO_3 Concentrations

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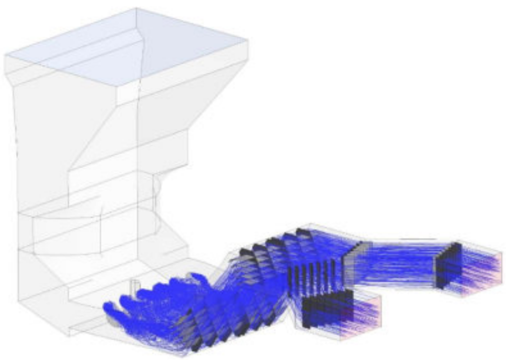
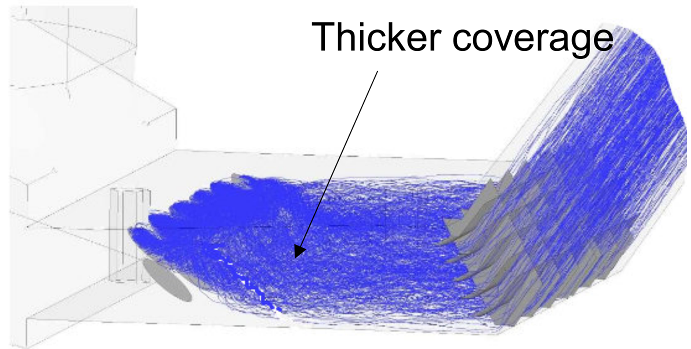
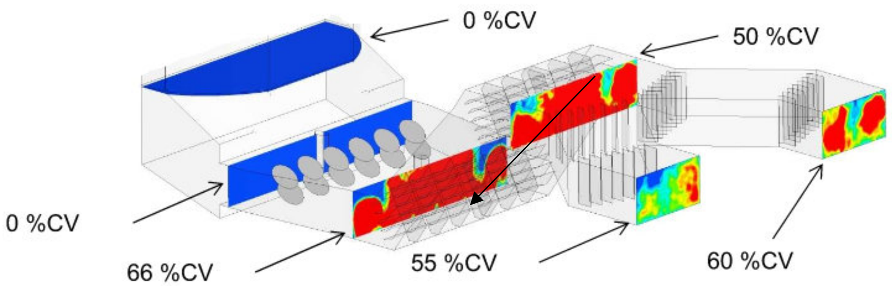
CFD Model – Simulated Static Mixing Plates (Not Optimized)



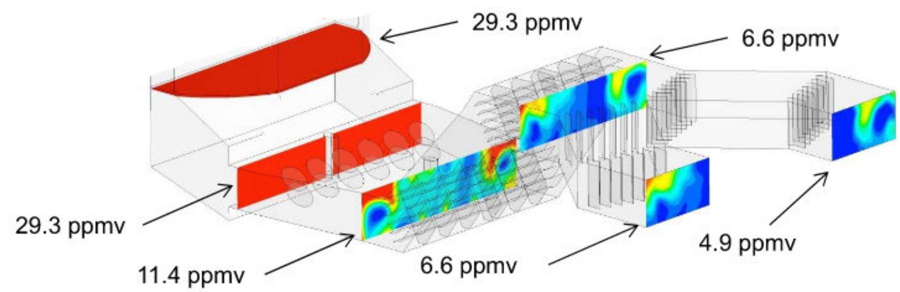


Particle Trajectories

Calculated 87% SO_3 removal at 2,200 lb/h hydrated lime injection rate per side.



Sorbent Variation Coefficient
1/3 Baseline Cv.



Calculated SO_3 Concentrations

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Physical Flow Model

- Optimized Delta Wing® sorbent mixing pre-AH and post AH.

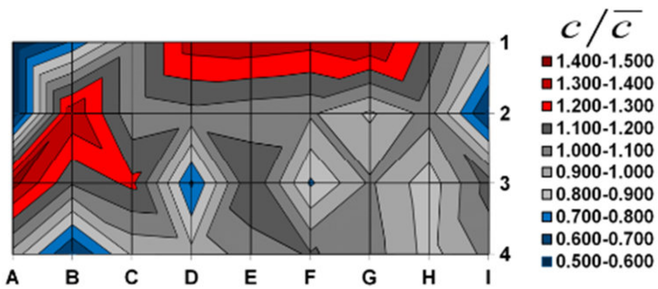

Table 3: Normalized sorbent distribution, $c/\bar{c}$, at the Air Heater inlet

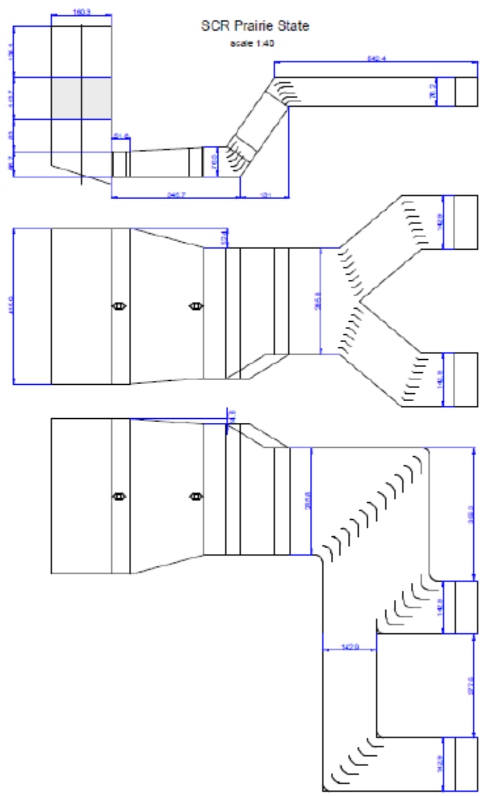

Figure 4. Physical Flow Model Layout.

Figure 5. Physical Flow Model Configurations.

Physical Flow Model – Post AH

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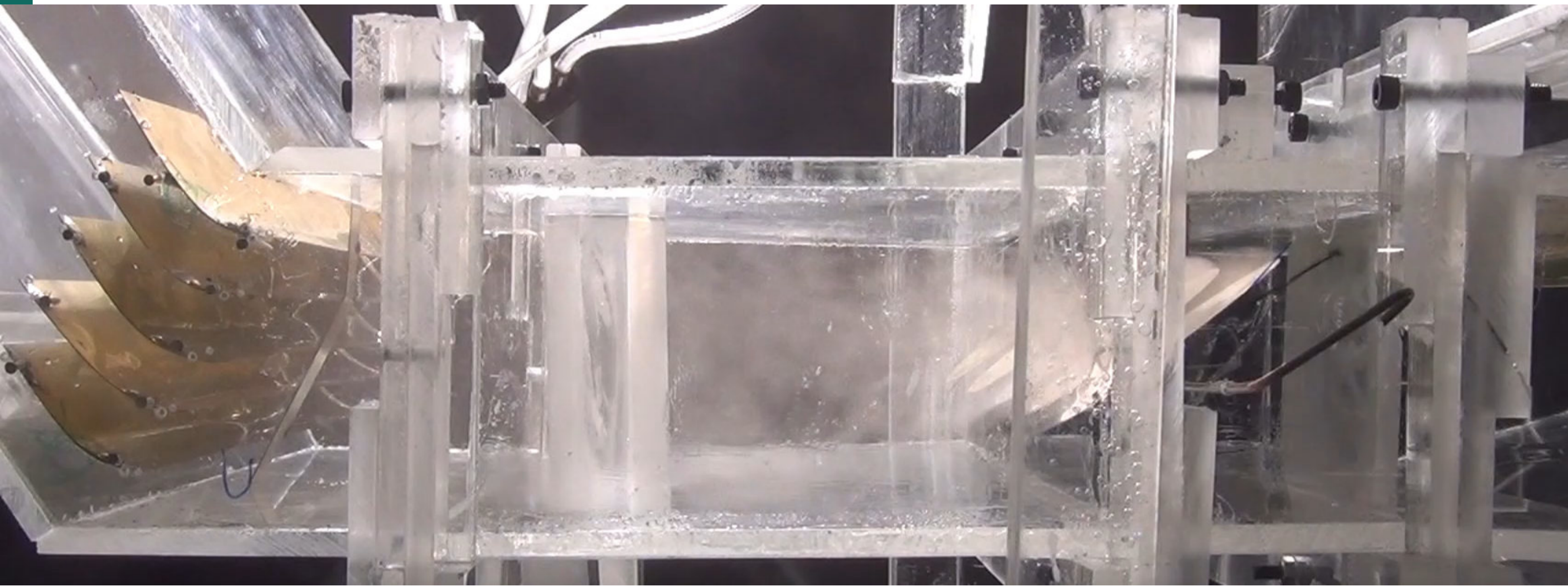

Flow Visualization

DB1

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Physical Flow Model Results
Optimized Delta Wing® Mixers

Location	Target Sorbent Coverage, Cv (%RMS)
Air Heater Inlets	30
Dry ESP Inlets	15

Location	Duct	Measured Sorbent Coverage, Cv (%RMS)
Air Heater Inlets	A & B	26.2
Dry ESP Inlets	A Left (West)	5.43
	A Right (East)	5.26
	B Left (West)	7.84
	B Right (East)	5.94

- Minimal pressure loss.
- Recommended no change to the existing A & B duct to ESP turning vanes.

Slide 18

DB1 Do not include actual pressure drop numbers in the presentation. Would prefer to remove this slide and speak to “minimal” pressure drop difference in the presentation.
Birch, Derek, 2026-05-07T17:40:28.796

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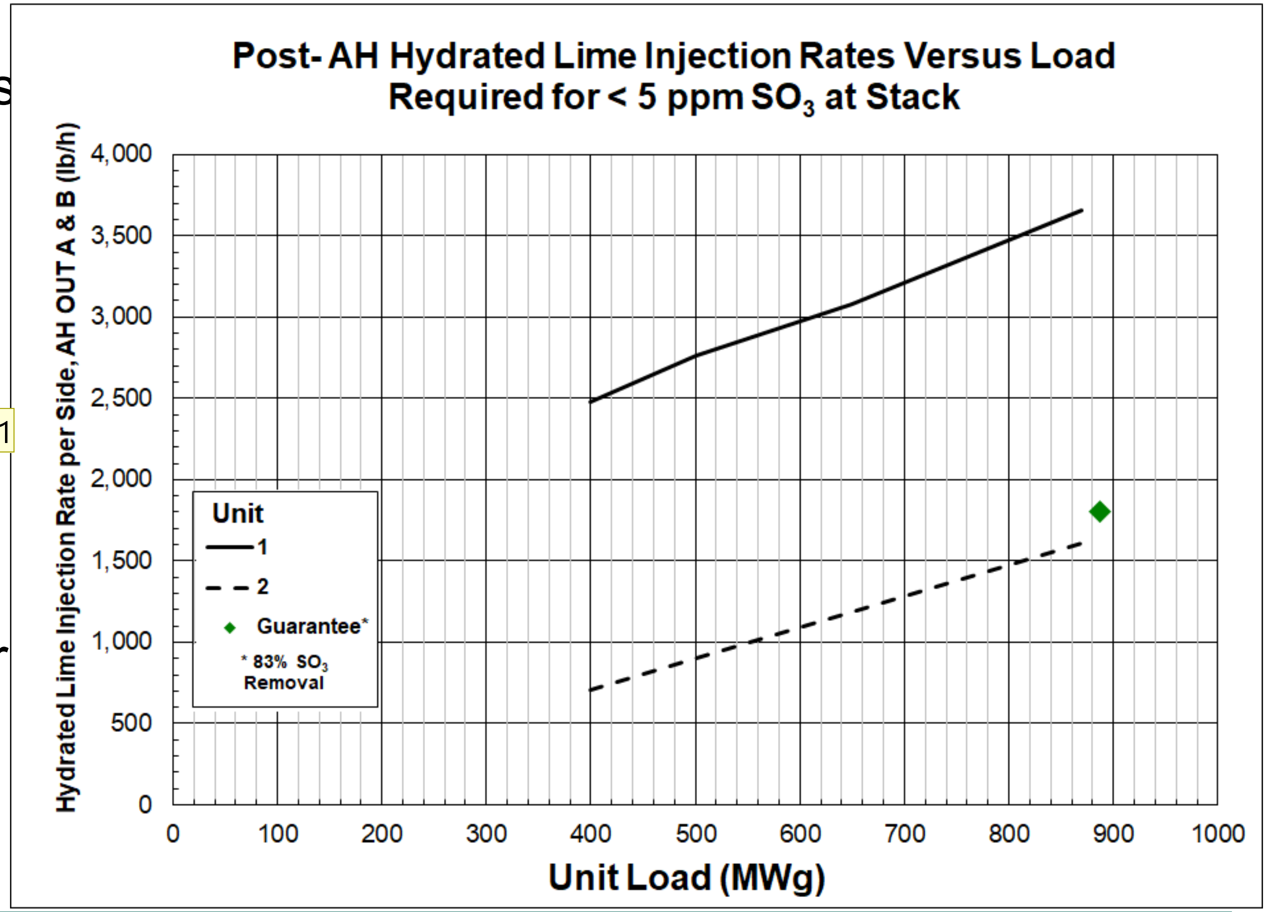
Hydrated Lime Consumption Before Upgrade

- PSGC installed weigh feeders in the unit 1 and unit 2 hydrated lime silos during phase 3 engineering.
- Feeders verified unit 1 consumption > two times unit 2.
- Guarantee was developed for 30 ppm uncontrolled SO_3 before weigh feeders.

DB1



Slide 19

DB1 Usage rate discrepancy was known before this but the weigh feeders verified actual consumption rates.

Birch, Derek, 2026-05-07T17:39:35.622

New Delta Wing® DSI Design Basis

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- Unit 1 selected for static mixers first due to higher consumption than Unit 2.

DB1

Parameter	Design Value	Notes
Unit Load	883 MWg	BMCR
Fuel	Illinois Bituminous	3.7% Sulfur, 24% Ash
DSI Injection	Post Unit 1 Air Heaters, A & B	
Total Flue Gas Flow (lb/h)	8,400,000	
Temperature (°F)	332	
Uncontrolled SO_3 (ppmw)	31	
SO_3 Capture (%)	>84	< 5ppm at stack
Sorbent	High Reactive Mississippi Lime	<10 sec reactivity
Total Sorbent Rate Injection (lb/h)	3,600	
Normalized Stoichiometry (lbmol $Ca(OH_2)$/lbmol SO_3	5.6	Based on 30 ppm uncontrolled SO_3

Slide 20

DB1 We knew U1 was using more just based on truck deliveries. Please reword this.

Birch, Derek, 2026-05-07T17:38:41.676

Unit 1 Dry Sorbent Injection P&ID After Upgrade

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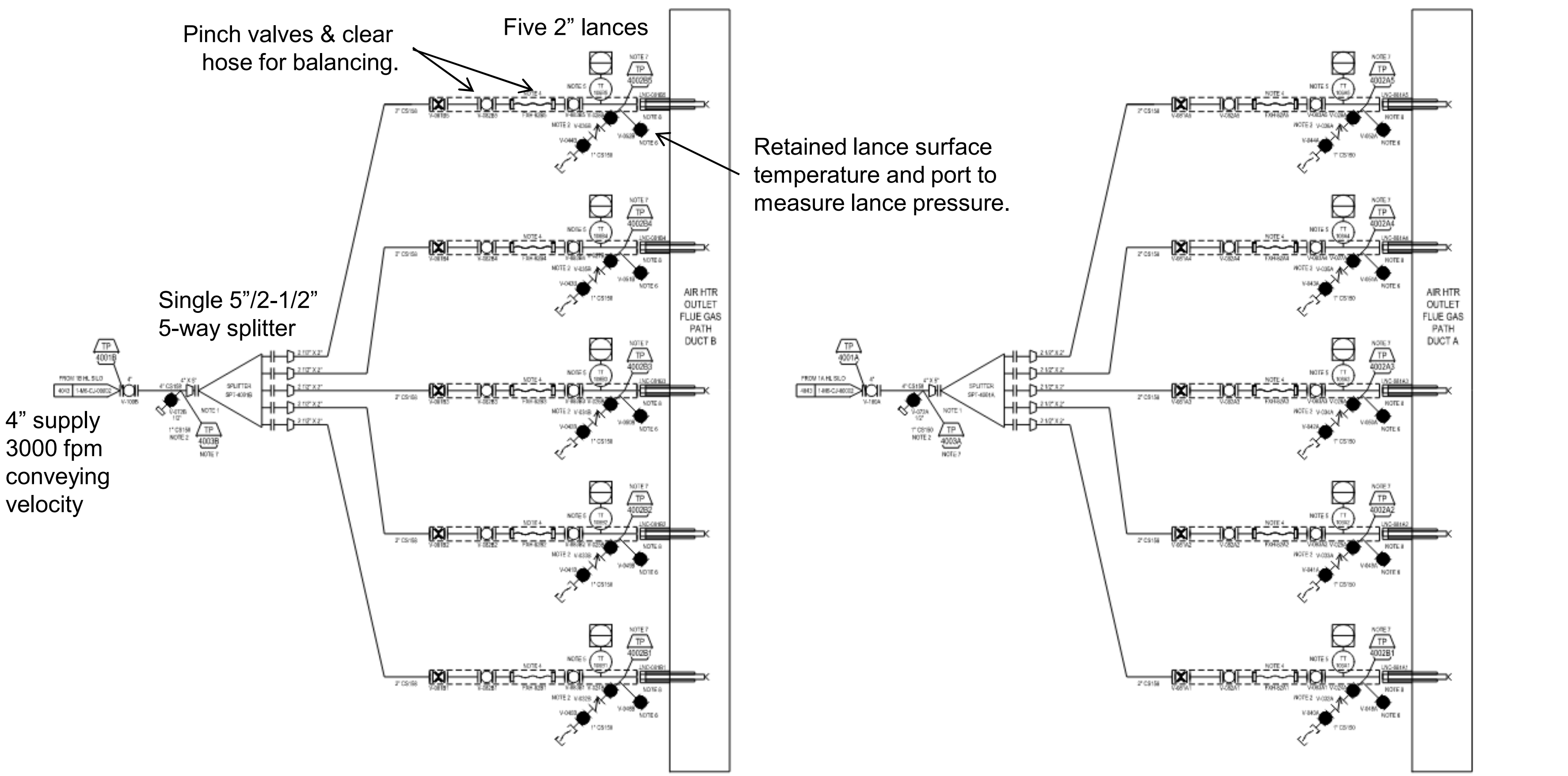
Same supply, splitters, and lances on both sides, A & B



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Unit 1 Dry Sorbent Injection Pipe Layout After Upgrade

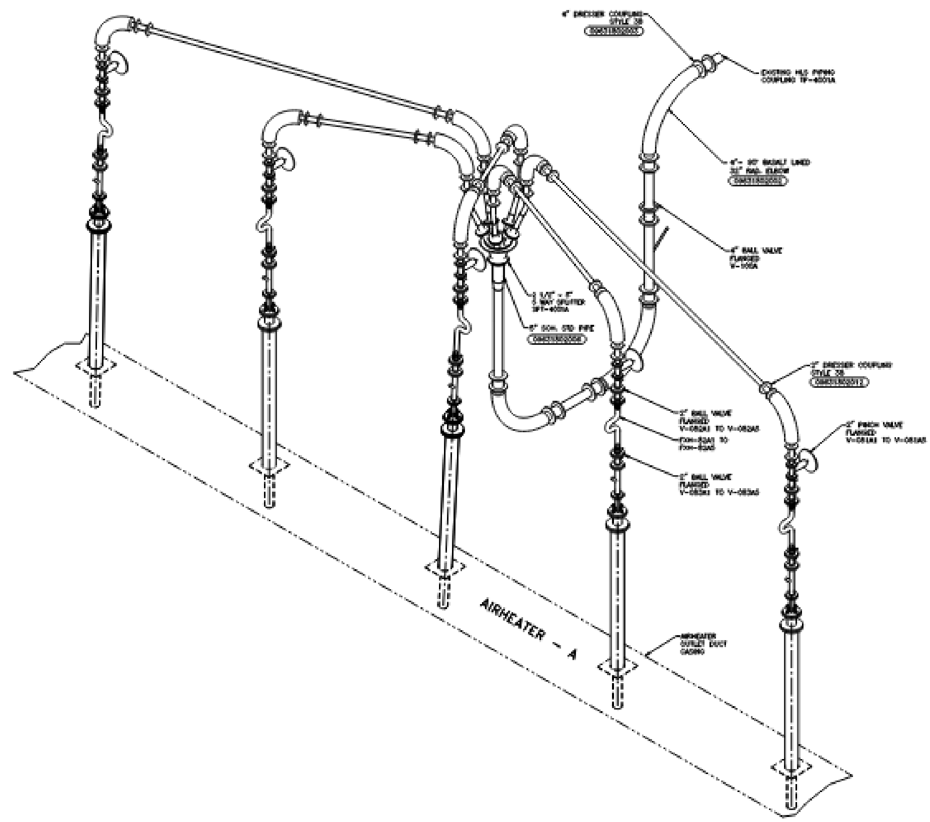
Post AH Sides A & B

- Single Vertical 1 x 5 Splitters
- Five (5) 2” Bore Injection Lances

Distributes and Avoids Plugging

- 2” Pinch Valves
- Clear Hose
- Lance Surface Temperature and Pressure Ports

Visualize and Balance Flows



Unit 1 Dry Sorbent Injection Lances After Upgrade

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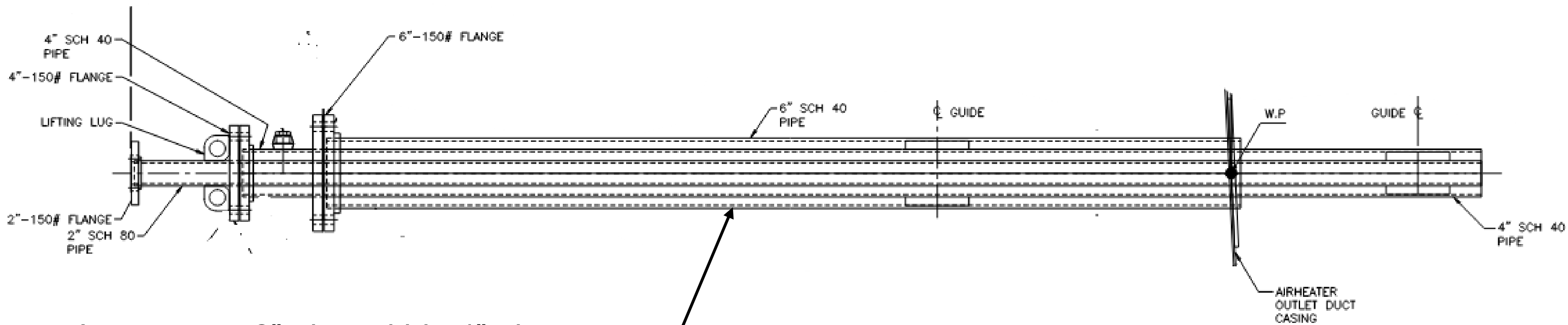

Lances are 2" pipe within 4" pipe to keep inner pipe cool with ambient air, if needed, to avoid plugging. They were mounted on a 6" ports installed on top of the air heater outlet duct.

Unit 1 Dry Sorbent Injection System After Upgrade

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Five (5) Static Mixers Per Duct

Five (5) Large Bore Pipe in a Pipe Injection Lances

Vertical splitters with long inlet L/D.

Unit 1 Dry Sorbent Injection System
Hydrated Lime Consumption After Upgrade

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From silos

Vertical flow to splitter for even splitting.

Pinch valves to balance lance pressures.

Clear hose to see flow to each lance.

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Findings

- After restarting dry sorbent injection after the upgrade, Unit 1 hydrated lime consumption was 56% lower than before for < 1 ppm SO_3 stack emission.
- There has been no plugged lances given fewer, larger bore lances used for Delta Wing® mixing.
- It has been easier to optimize equal lance hydrated lime injection seeing flow through clear hose and using pinch valves to balance lance pressures.

DB1 Our emission limit is 1 ppm. Please correct.
Birch, Derek, 2026-05-07T17:41:27.466

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Findings (continued)

- We believe that improved hydrated lime splitting and in-duct Delta-Wing® mixing both contributed to significantly improve hydrated lime consumption at the Unit 1 air heater outlet.
- A duplicate dry sorbent injection upgrade is currently being procured for the Unit 2 air heater outlet.
- We expect reduced hydrated lime consumption in Unit 2 but not as much as a percentage given significantly less Unit 2 baseline consumption than Unit 1.
- A new pre-AH Delta-wing® system was similarly optimized by CFD and physical flow model, but it is on hold until after post AH system are installed and operated.

Questions

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