REINHOLD ENVIRONMENTAL Ltd.

2014 NOx-Combustion Round Table & Expo Presentations

February 10 & 11, 2014, in Charlotte, NC / Hosted by Duke Energy

Reinhold Environmental LTD
2014 NOx Conference/PCUG Conference

- Elimination of Ash Piling -
The Kincaid Generation Story

February 11th, 2014

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&

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Kincaid Generation

Kincaid Generation, L.L.C. is a two generating unit thermal electric generating plant that is operated in a safe, clean, reliable, and efficient manner. Unit 1 started commercial service in 1967, and Unit 2 in 1968. Steam is generated by Babcock and Wilcox cyclone fired universal pressure boilers. Each boiler is capable of producing 4.2 million pounds of steam per hour.

Kincaid Generation

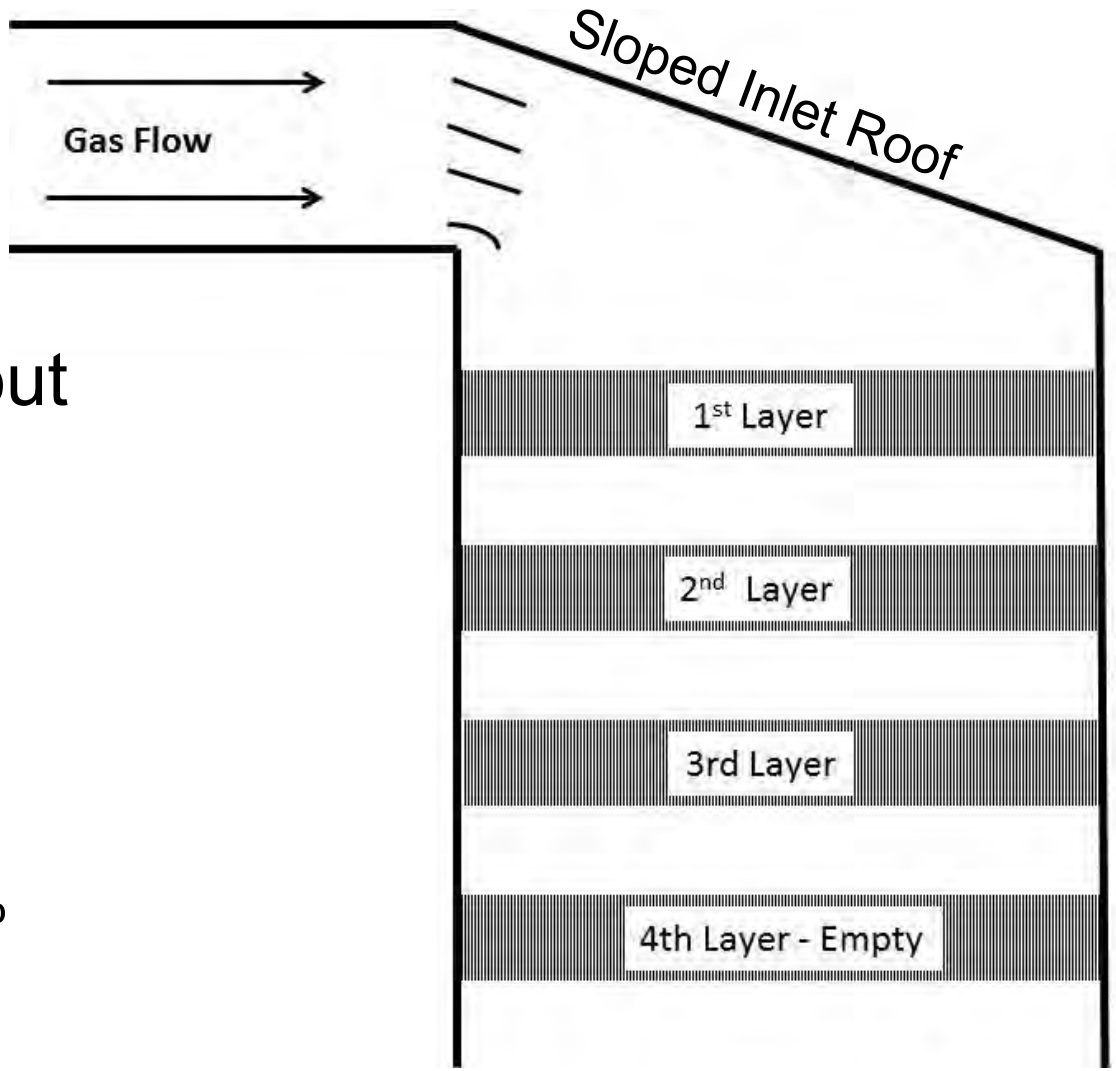
Boiler: Unit 1 600 MW
Unit 2 600 MW

Fuel: PRB

SCR Startup: 2003

Both reactors operated in the Ozone Season from 2003 – 2012. The reactors went into year round operation in 2013. One (1) reactor box per boiler.

Kincaid Generation



3 + 1 Catalyst Layout

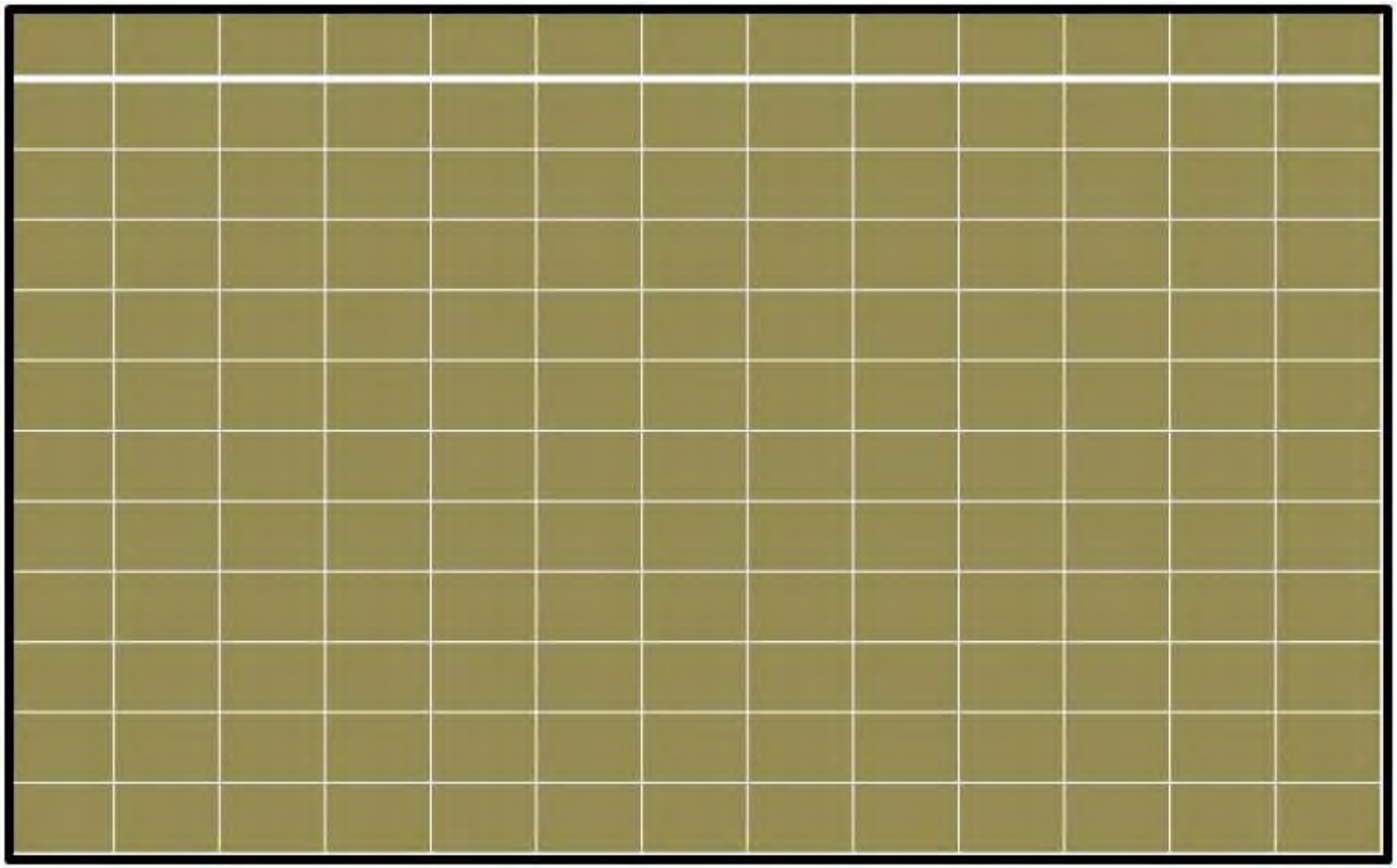
Original Catalyst

Type: Honeycomb
OEM: Cormetech
Pitch: 8.2 mm
Length: 890 mm

DeNOx Efficiency: 90%

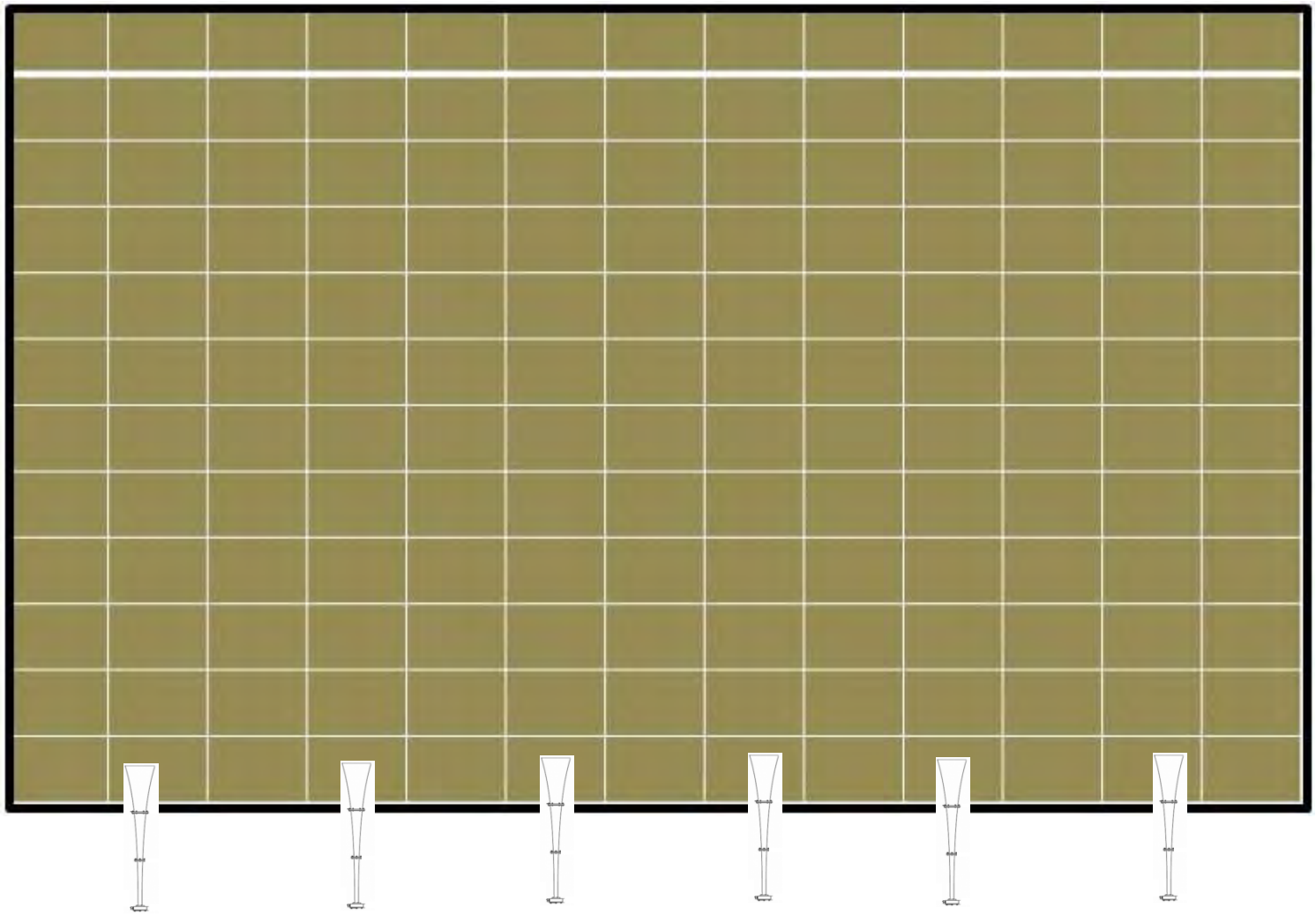
Kincaid Generation

156 Catalyst Modules per Layer
13 by 12 Arrangement



Kincaid Generation

On Line Cleaning System: Six (6) Model D-75s per Layer
The acoustic cleaners are installed along the front wall of the reactor

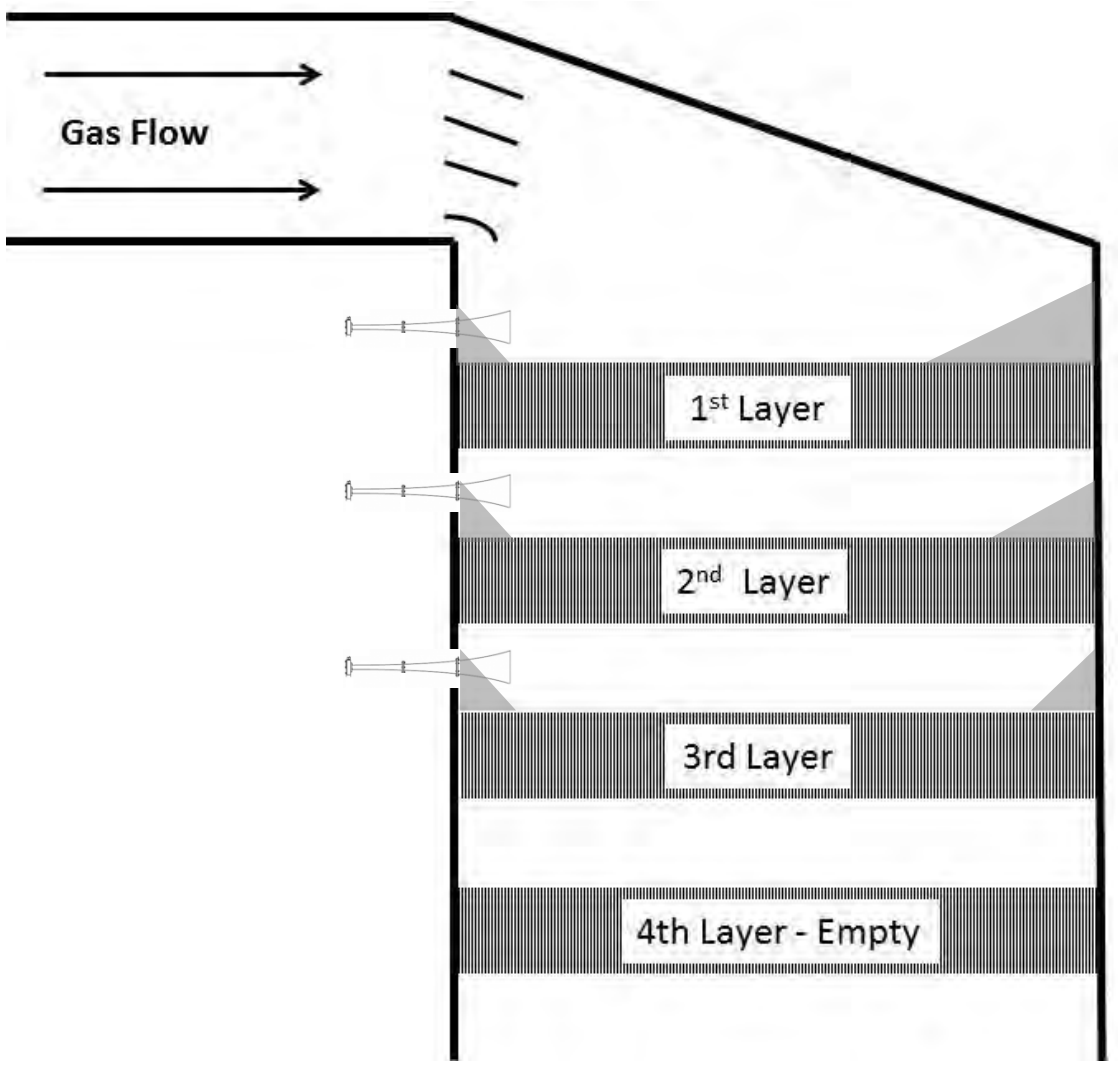


Kincaid Generation

Model D-75 Acoustic Cleaner

Kincaid Generation

Both reactors suffered with ash piling along the front and rear walls.



Kincaid Generation

Ash Piling Issue

Front Wall

Rear Wall

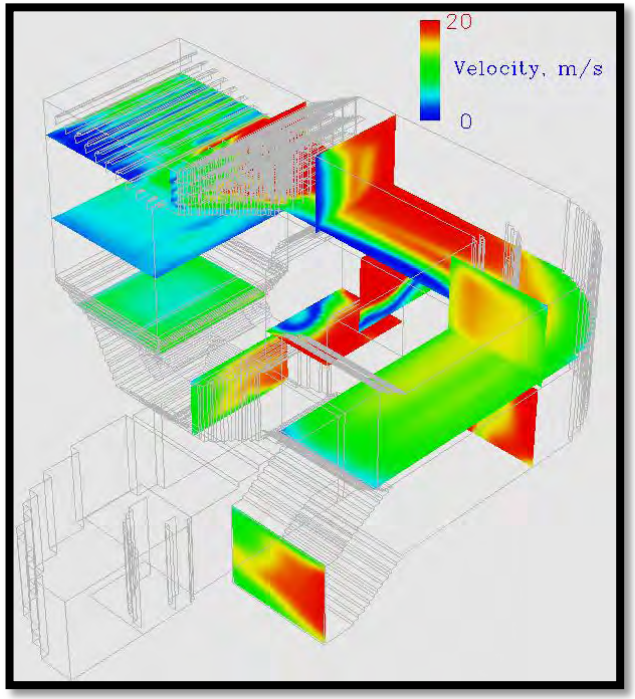
Ash Piling in SCR Reactors – Why?

2 Main Reasons

1. Popcorn Ash/LPA

Example of Popcorn Ash

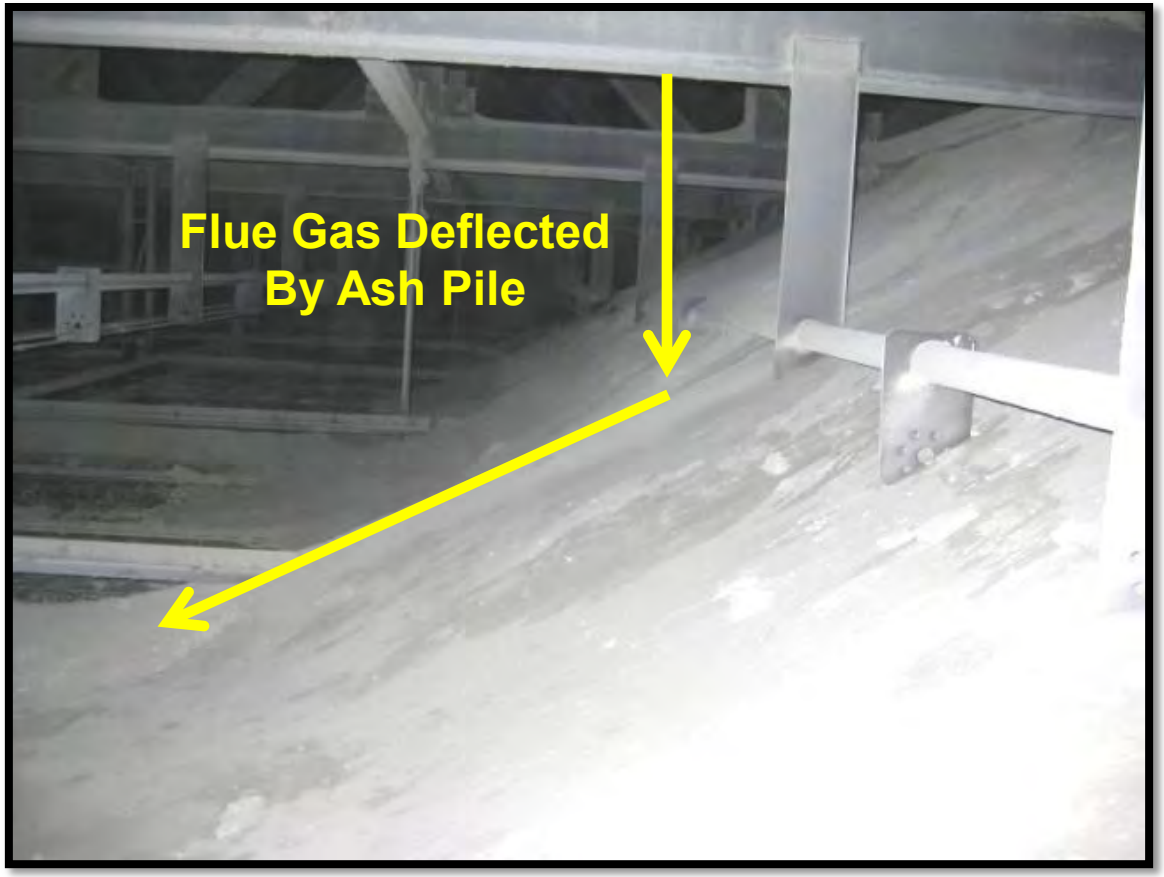
2. Poor Gas Flow & Ash Distribution



Operational/Maintenance Issues from Ash Piles

- Loss of DeNOx Potential
- Decreased Catalyst Life (Plugged & Poisoned)
- Reduction in Mercury Oxidation
- Increased Manual Cleaning
- Higher Ammonia Usage & Slip
- Increased Pressure Drop
- Increased ID Fan Power Consumption

Ash Erosion will Destroy the Catalyst



The catalyst modules that are adjacent to ash pile experiencing 3 times the normal erosion due to the increased velocity of the flue gas & the angled flow of the flue gas. The remaining catalyst modules are experiencing twice the normal erosion due to the increased velocity of the flue gas.

Typical Approaches to Solving Ash Piling Issues

- Catalyst Change Out
  - Larger Pitch
  - Honeycomb to Plate
- Flow Model Studies
  - Physical & CFD
- Modifying Turning Vanes & Other Control Devices
- Installing/Adjusting LPA Screens

It is common for plants to switch to larger pitch catalyst or from honeycomb catalyst to plate catalyst to minimize ash piling issues. The results have been mixed.

This approach comes with a sacrifice of DeNOx potential!

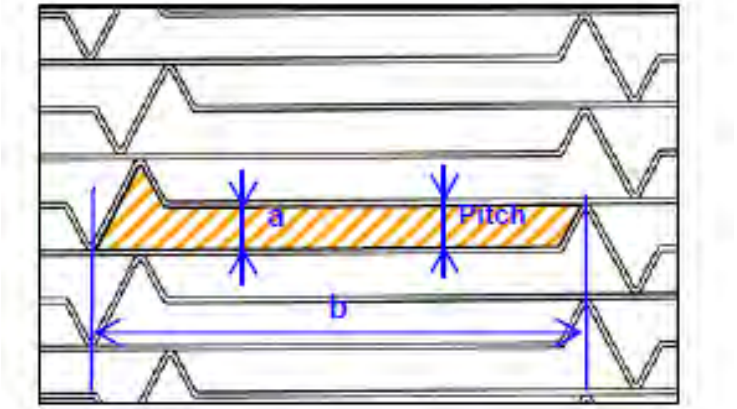
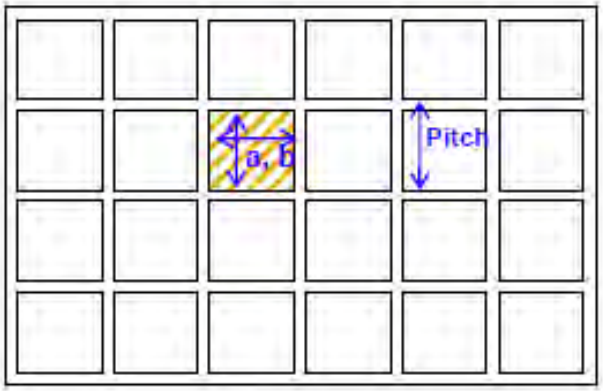


Plate type

Typical Pitch: 5.7 – 7.0 mm

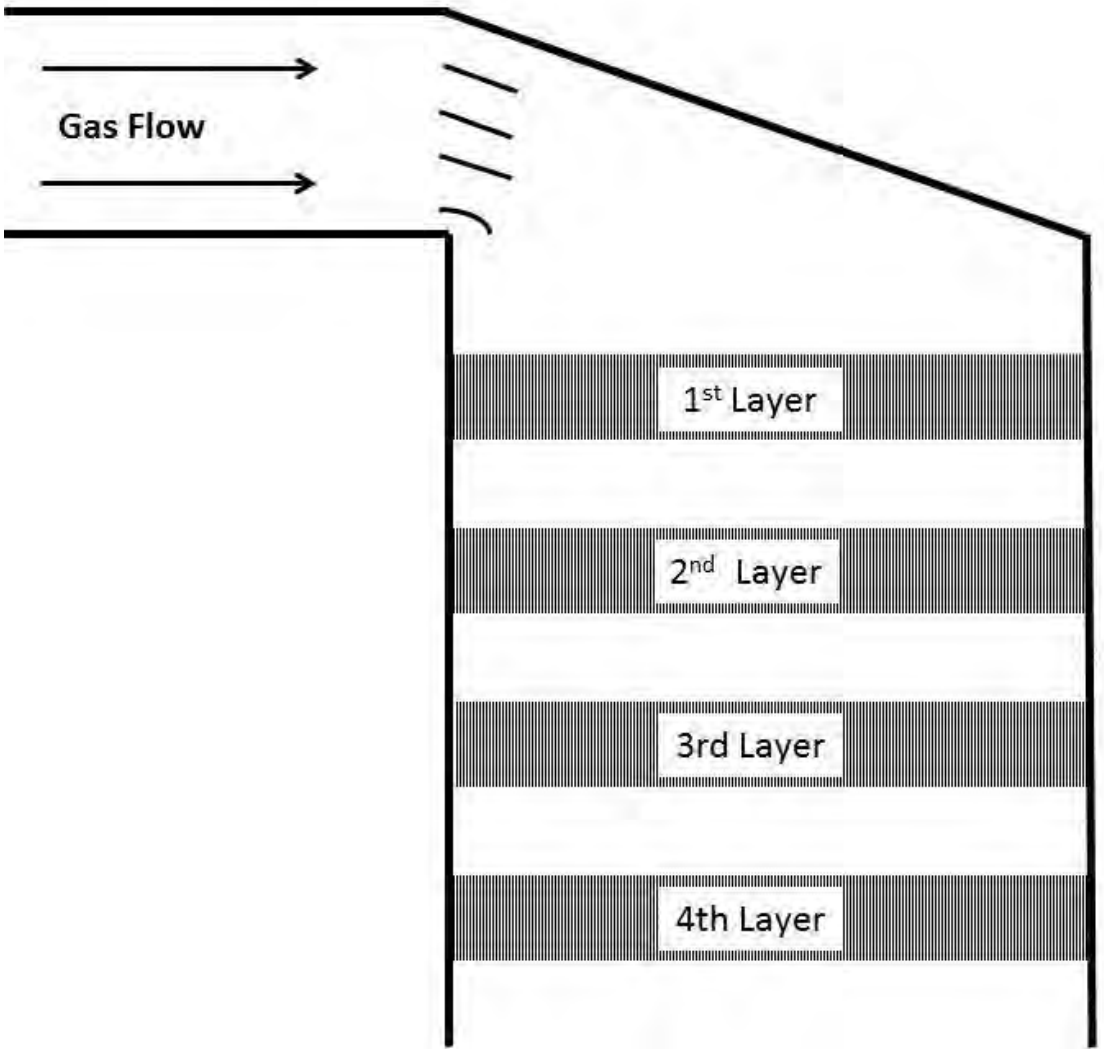


Honeycomb type

Typical Pitch: 6.9 – 9.2 mm

Kincaid Generation

Heading into 2013, the reactors were fitted with four (4) catalyst layers.



8.2 mm – 890 mm

8.2 mm – 890 mm

8.2 mm – 890 mm

8.2 mm – 1,350 mm

Kincaid Generation

Spring of 2013
Innovative Ash Piling Solution Plan

#1: Design an Interlayer Flow Gradient

#2: Up-Grade the Acoustic Cleaners

#3: Installing Ash Sweepers along Rear Wall

Interlayer Flow Gradient

The front & rear walls were fitted with 8.2 mm - 1,350 mm catalyst modules
The remaining layer was fitted with 6.9 mm - 1,350 mm catalyst modules

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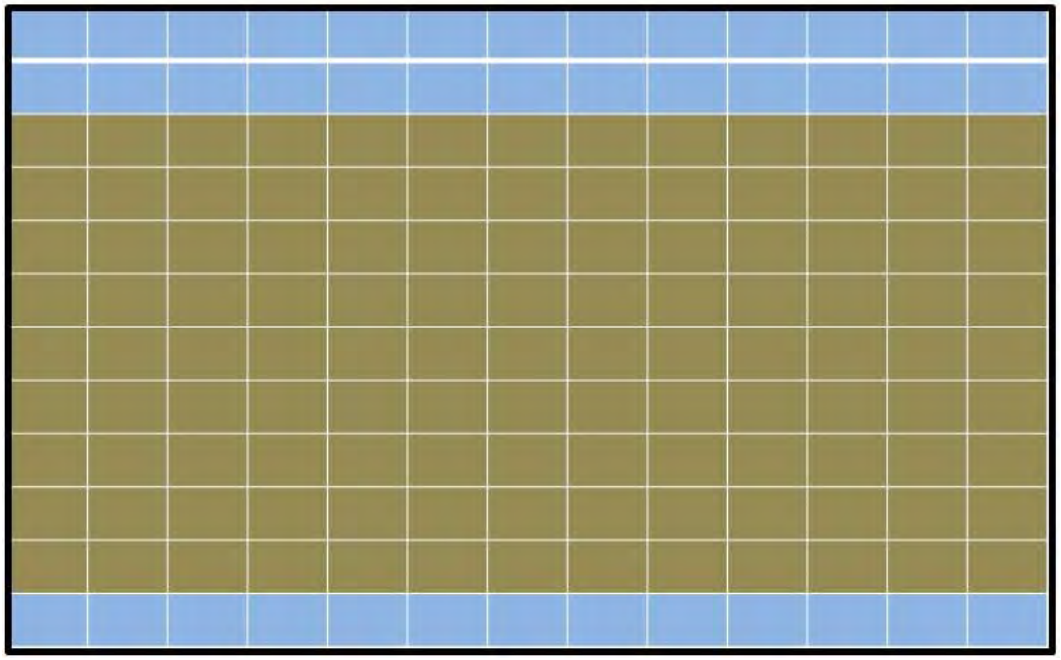
This design encourages preferential
gas & ash flow in known ash piling areas.

8.2 mm - 1,350 mm
39 Modules
25% of the Layer

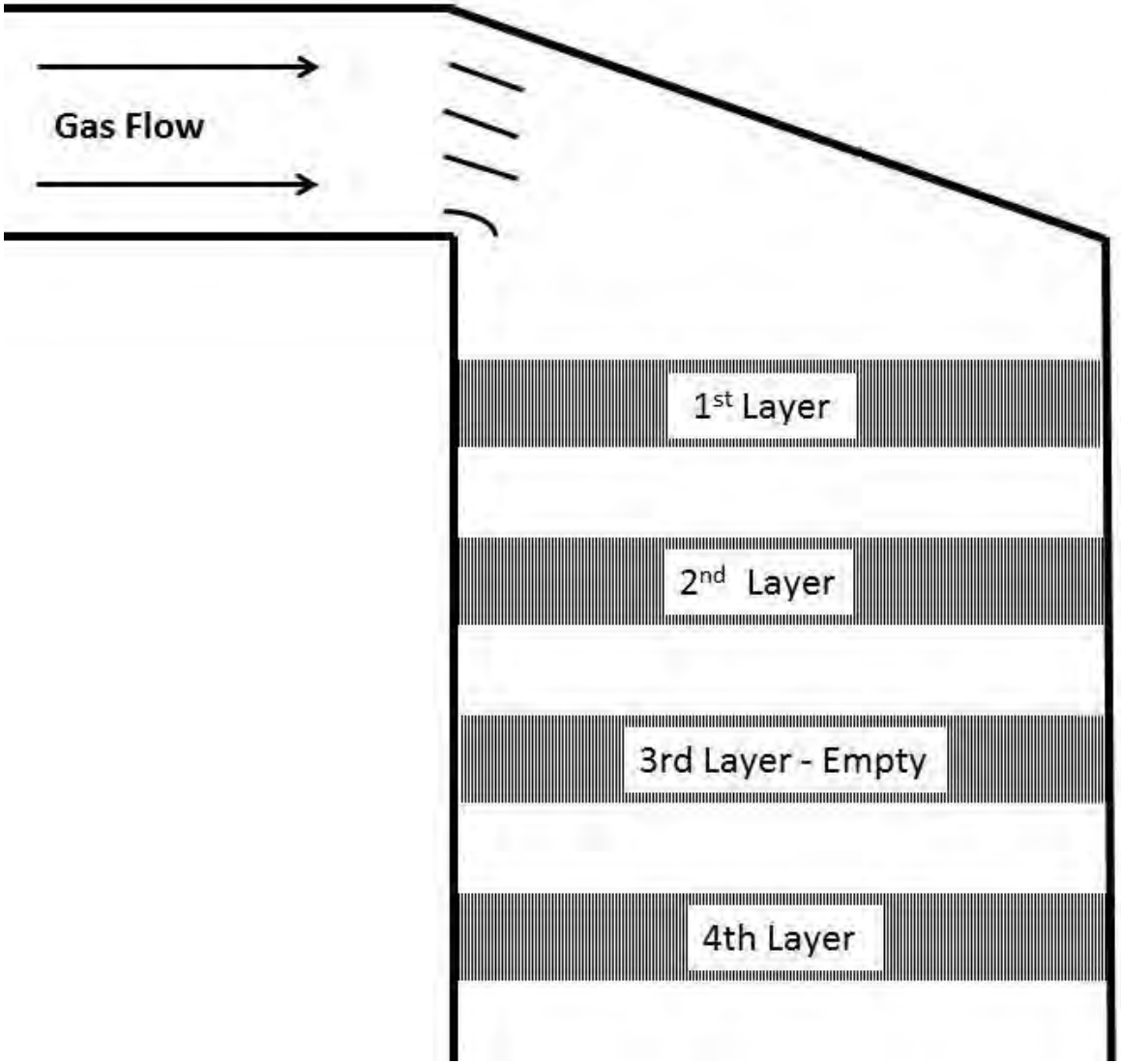
6.9 mm - 1,350 mm
117 Modules
75% of the Layer



~70% More Surface Area (DeNOx Potential) than the Original Layer

Kincaid Generation

New Catalyst Layout



1st & 2nd Layers Combination:
8.2 mm - 1,350 mm
6.9 mm - 1,350 mm

8.2 mm – 1,350 mm

Acoustic Cleaner Up-Grade

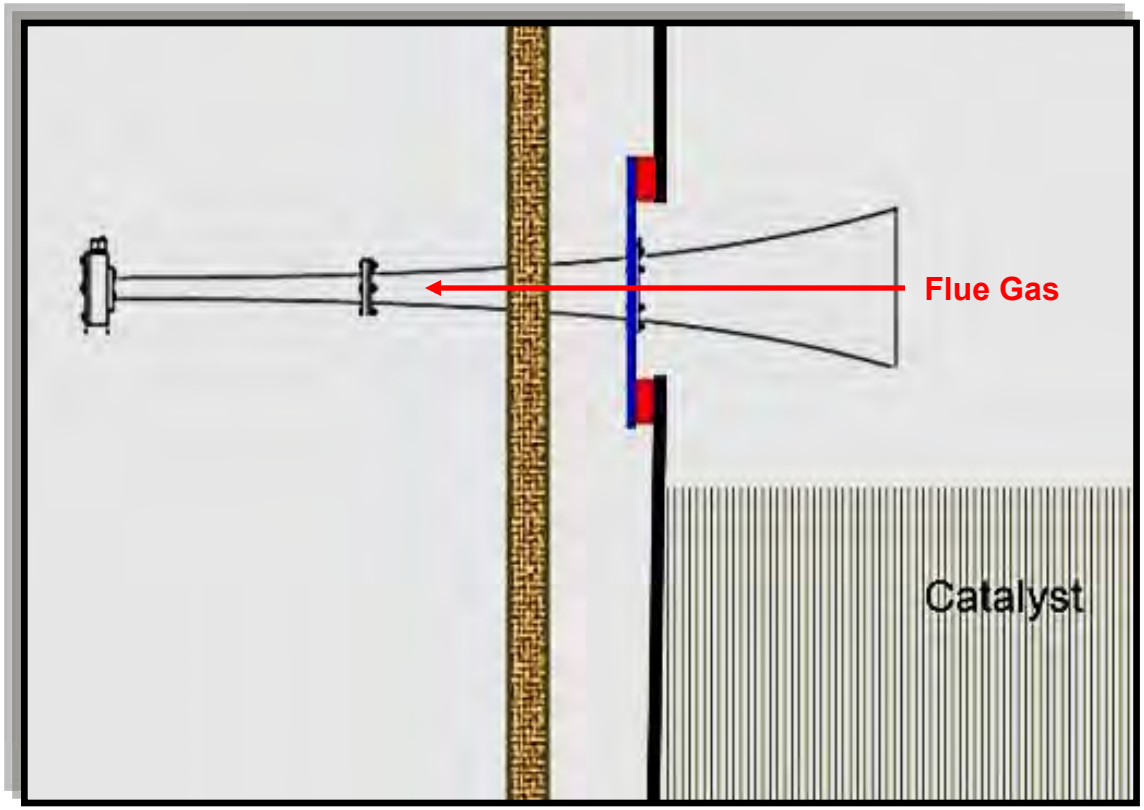
Better Concentration of Acoustic Energy in the Lower Frequency Bands
+ Increased dB Output Equals = Greater Particle Displacement

Model D-75

Model D-75 Retrofitted with
Mega Sound Generator

Maintenance Issue

The flue gas that backs into the bell sections is dropping below the acid dew point causing a slow steady growth of deposits.

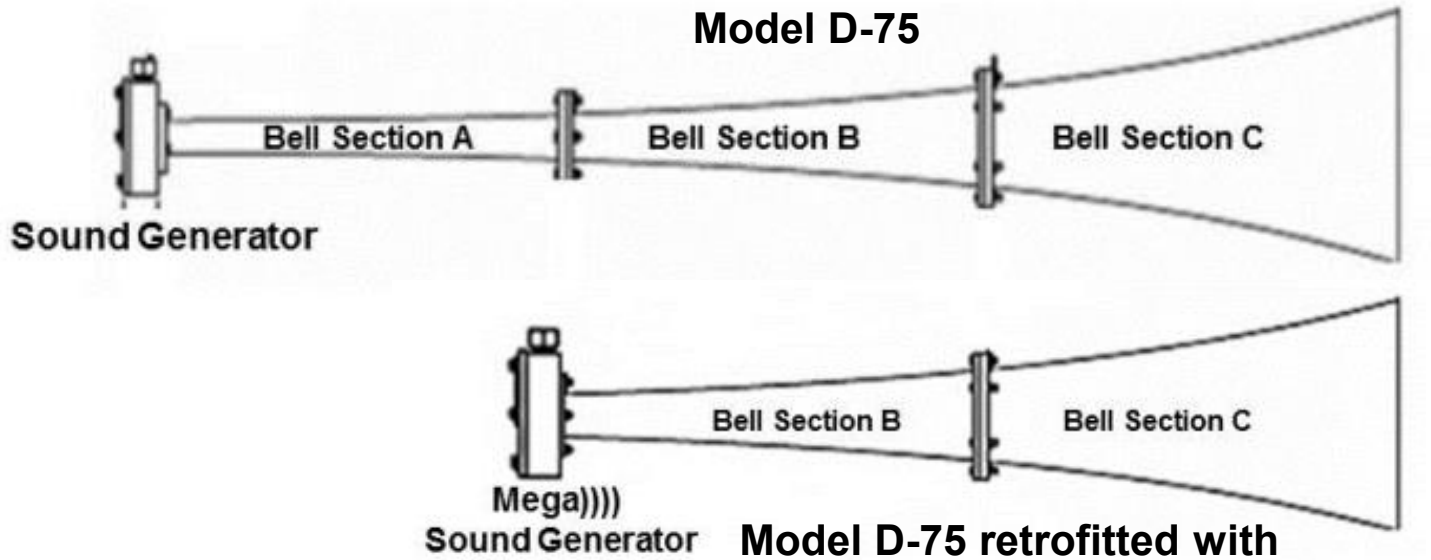


Maintenance Issue

This picture shows the hard, crusty deposits that can occur inside the bell sections of the acoustic cleaner when the flue gas is allowed to drop below the acid dew point.

Mega Sound Generator

All that is required is to remove Bell Section A and the current sound generator. The new Mega Sound Generator is then attached to the end of Bell Section B. This reduces the length of the Model D-75 by 30 inches.

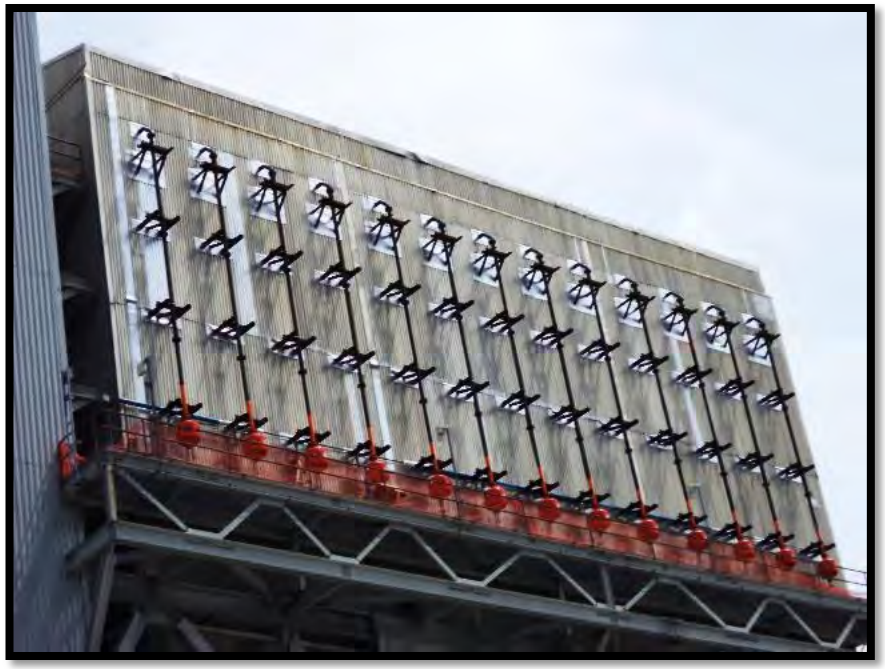


Model D-75 retrofitted with the Mega Sound Generator

Once retrofitted with the Mega Sound Generator, the length of the Model D-75 was reduced by 30”. This enabled the customer to eliminate the need for insulating the nominal amount of bell section protruding through the lagging wall.

Kincaid Generation

1st Catalyst Layer
Installed Ash Sweepers Along the Rear Wall



What is an Ash Sweeper?

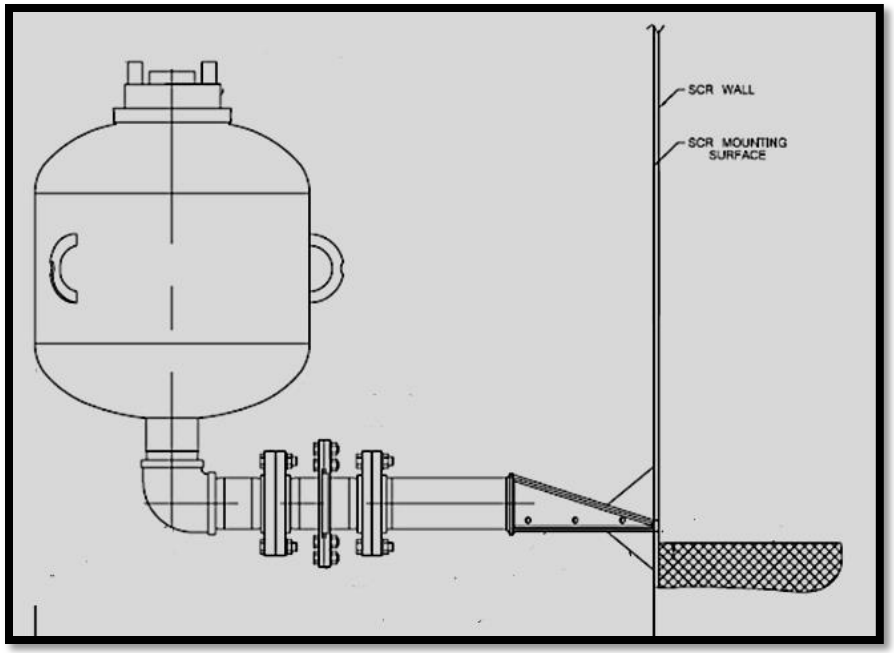
Uses eruption of compressed air to move material

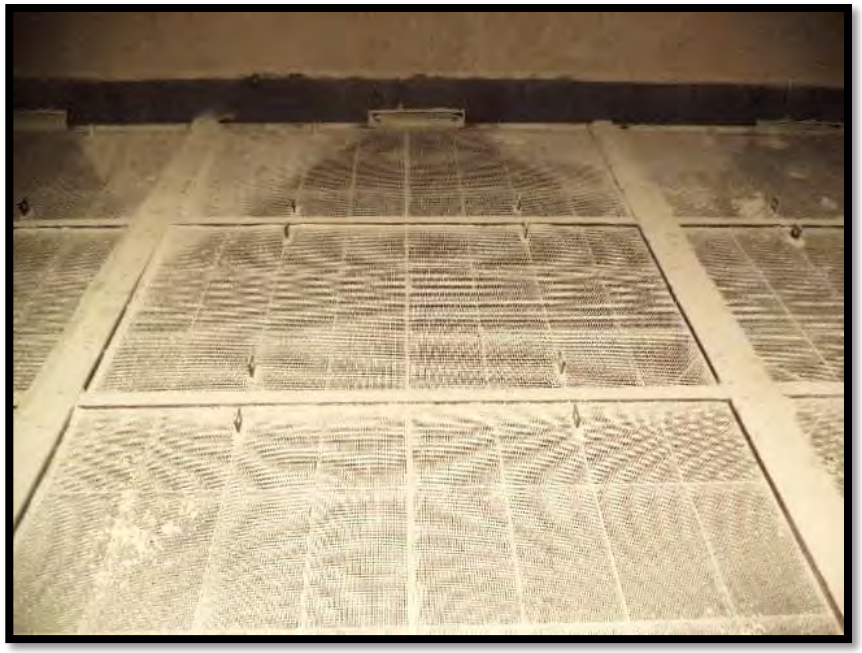
- Reservoir of compressed air discharges as an eruption into a storage or process vessel to promote flow and prevent material buildup
- Introduced ~1975, accepted across industry, around the world
- Common in power plants on coal bunkers and chutes
- Available as individual units *(one outlet per tank)*
- Or as multi-port system (*one tank serves several outlets)*

Individual Unit

Multi-Port Unit

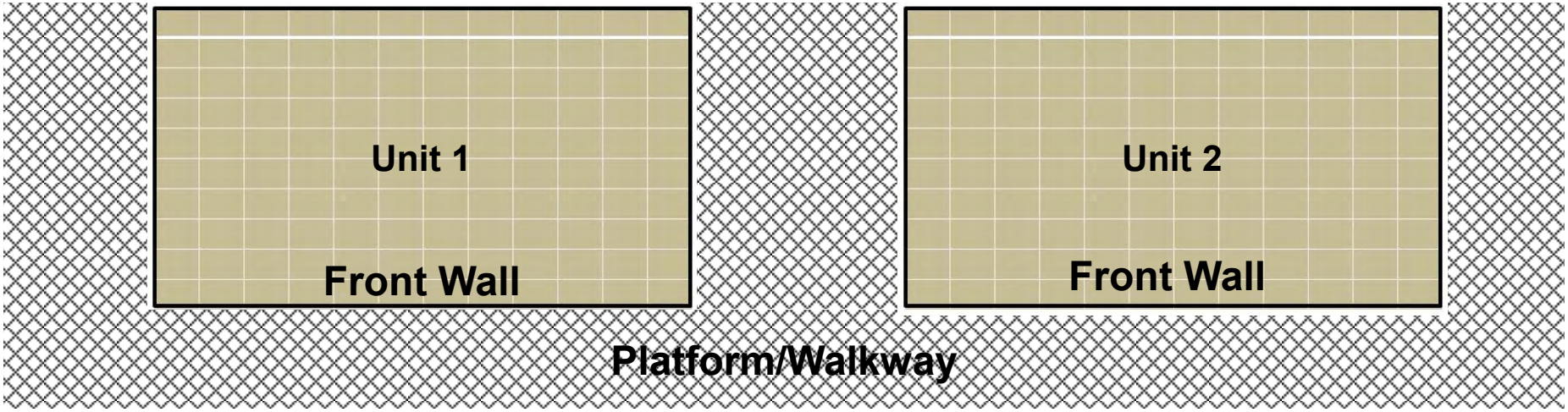
Ash Sweeper



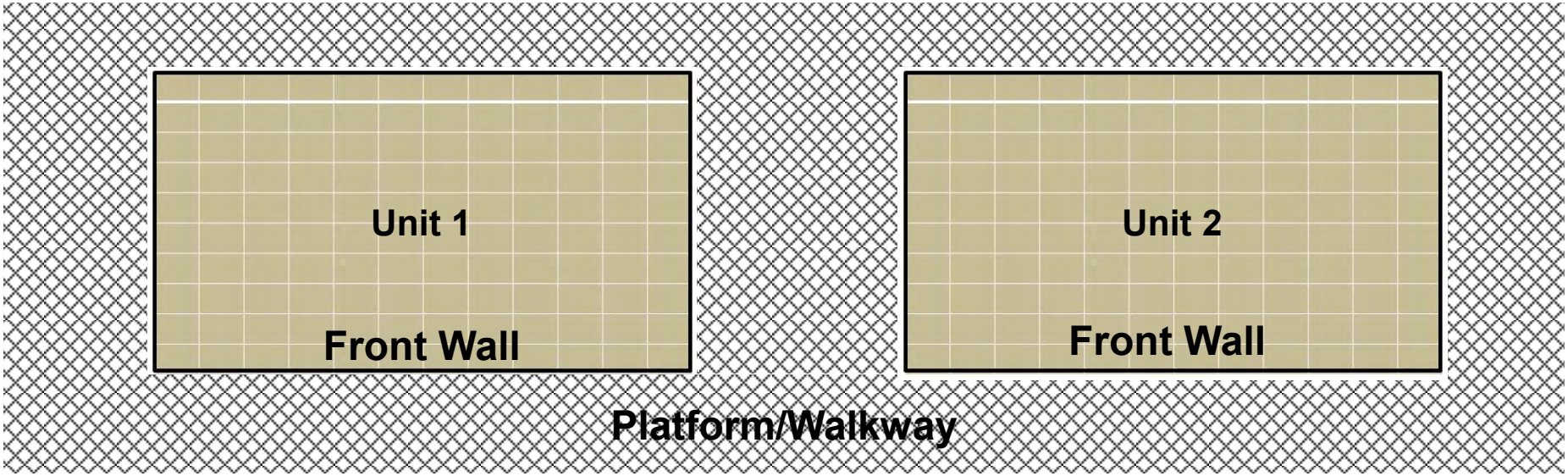


Kincaid Generation
Ash Sweeper Installation Challenges

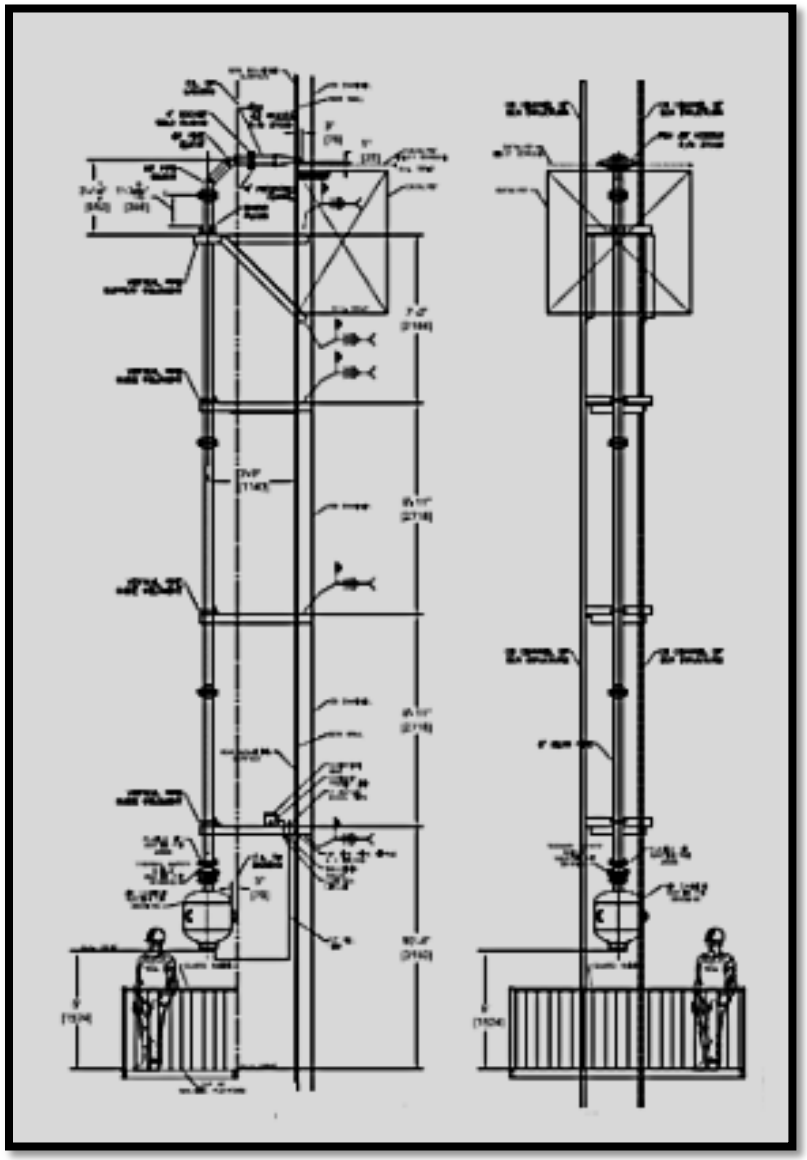
Kincaid Generation
1st, 2nd & 3rd Catalyst Layers



Kincaid Generation
4th Catalyst Layers



Ash Sweeper Installation



Ash Sweeper Installation

Fan Jet Nozzle

Ash Sweeper Installation

Ash Sweeper/Acoustic Cleaner Installation

11 Months After Implementation of Innovative Ash Piling Solution Plan

The ash piling issue has been eliminated with a 70% improvement to DeNOx potential!

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Questions?

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