REINHOLD ENVIRONMENTAL Ltd.

2018 NOx-Combustion Round Table & Expo Presentation

February 19-20, 2018, in St. Louis, MO / Hosted by Dynegy

2018 NOx-Combustion-CCR Round Table

February 19-20, 2018; Marriott St. Louis Airport Hotel, St. Louis, MO

Improved On-Line Catalyst Cleaning with the Latest Acoustic Cleaner Technology

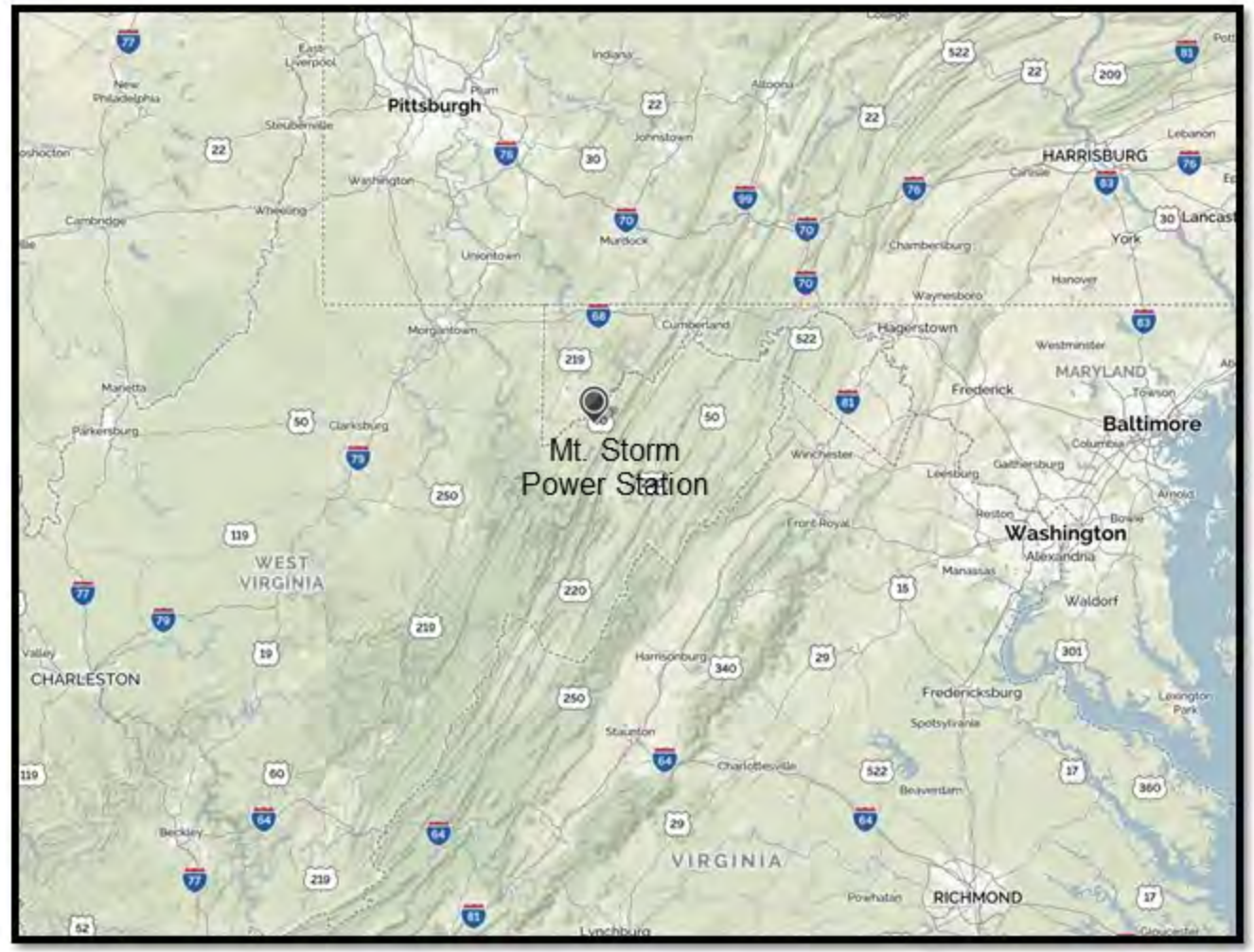
by Jake Shelton, Acoustic Cleaning Systems, Inc.
& Sean Ellifritz, Dominion Energy

Dominion Energy

ACS Acoustic Cleaning Systems

Dominion Mt. Storm Power Station

Mt. Storm Power Station is the largest coal-fired power station managed by Dominion. Mt. Storm's three units can generate more than 1,600 megawatts of electricity – enough electricity to power half a million homes. The station is located on Mt. Storm Lake in the rugged Allegheny Mountains of northeastern West Virginia. Mt Storm's Unit 1 went commercial in 1965, Unit 2 in 1966, and Unit 3 in 1973.



Dominion Mt. Storm Power Station

Unit 1 – 550 MW
Unit 2 – 550 MW
Unit 3 – 550 MW

Fuel: Eastern Bituminous

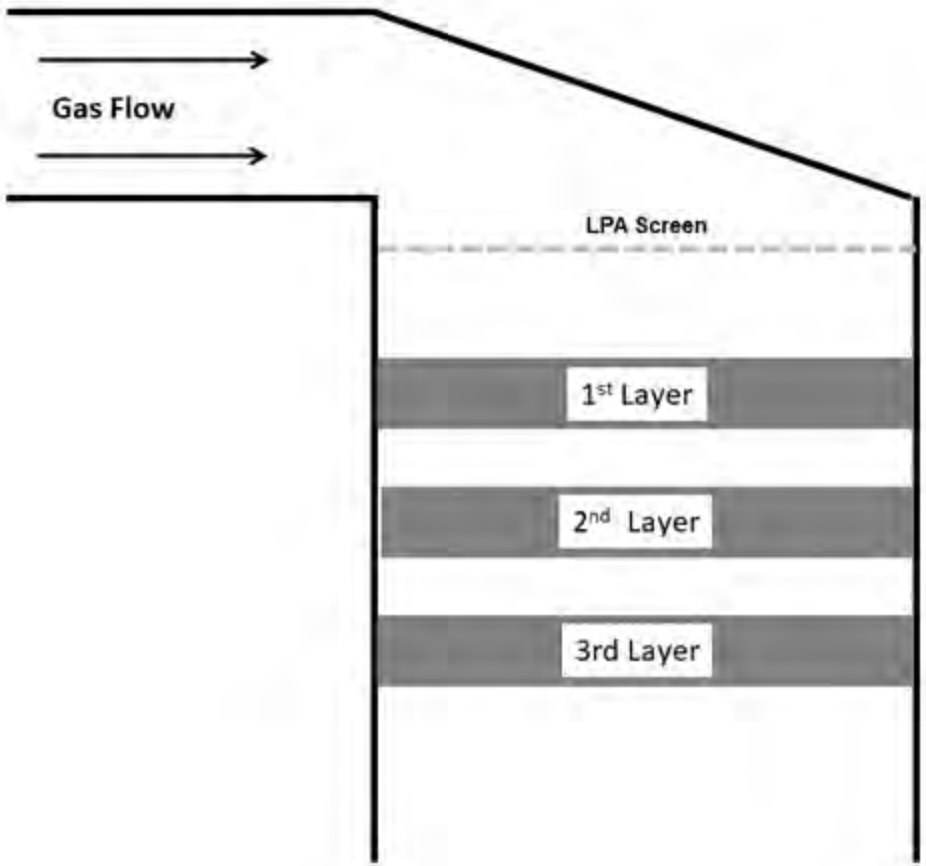
Boiler Facts:

- Average daily coal consumption is 15,000 tons
- Average daily limestone consumption is 700 tons

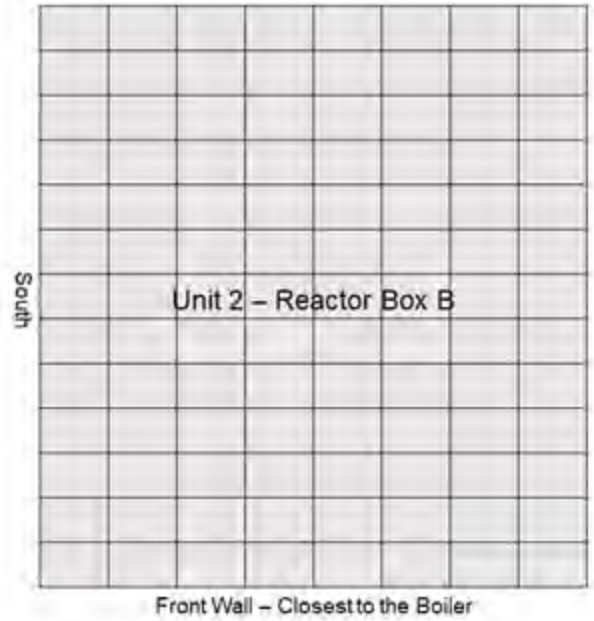
Dominion Mt. Storm Power Station
Unit 1, Unit 2 & Unit 3 SCR Reactors

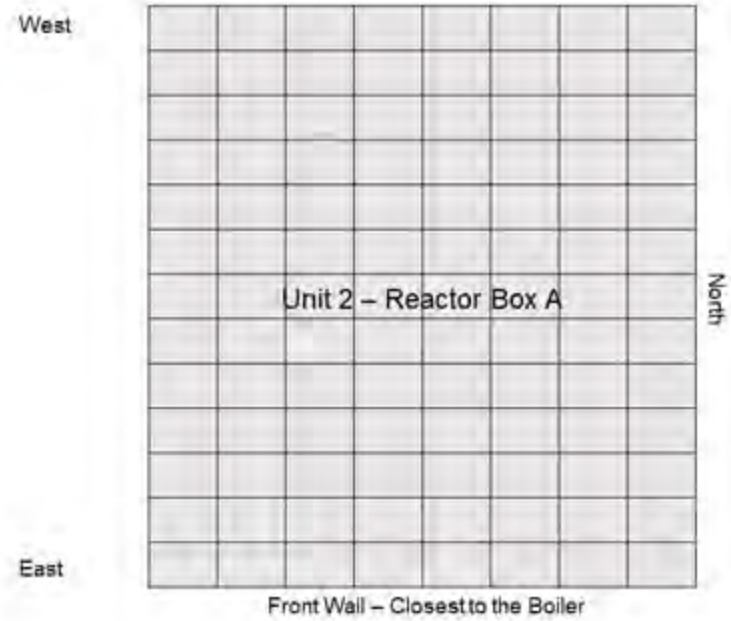
Reactors Boxes: 2
Layers per Reactor Box: 3
Type: Honeycomb
OEM: Cormetech
Pitch: 6.9 mm
Length: 1350 mm
De NOx efficiency: 90% DeNOx
(2 ppm NH_3 slip threshold)

Dominion Mt. Storm Power Station
Unit 1 & 2 SCR Reactors

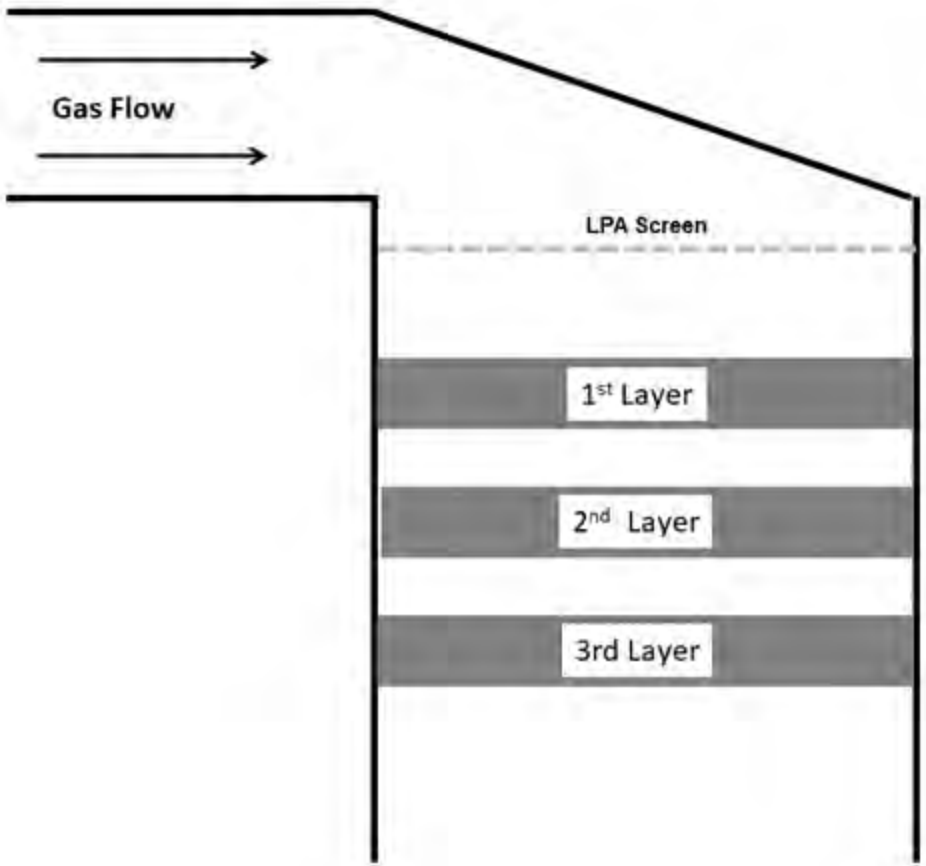


Unit 2 SCR – 2 Reactor Boxes – 3 Catalyst Layers
104 Catalyst Modules per Layer per Reactor Box - Layout: 13 by 8

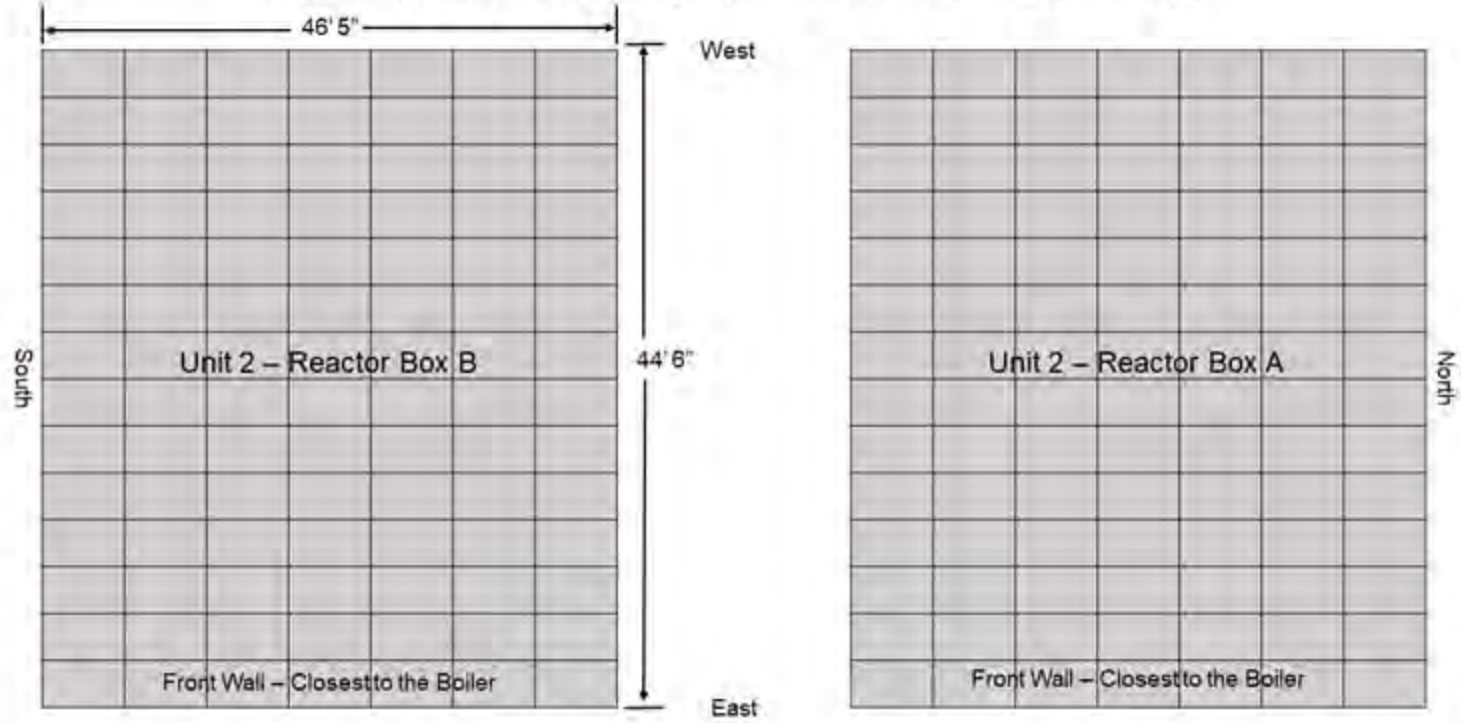




Dominion Mt. Storm Power Station
Unit 3 SCR Reactor



Unit 3 SCR – 2 Reactor Boxes – 3 Catalyst Layers
104 Catalyst Modules per Layer per Reactor Box - Layout: 14 by 7

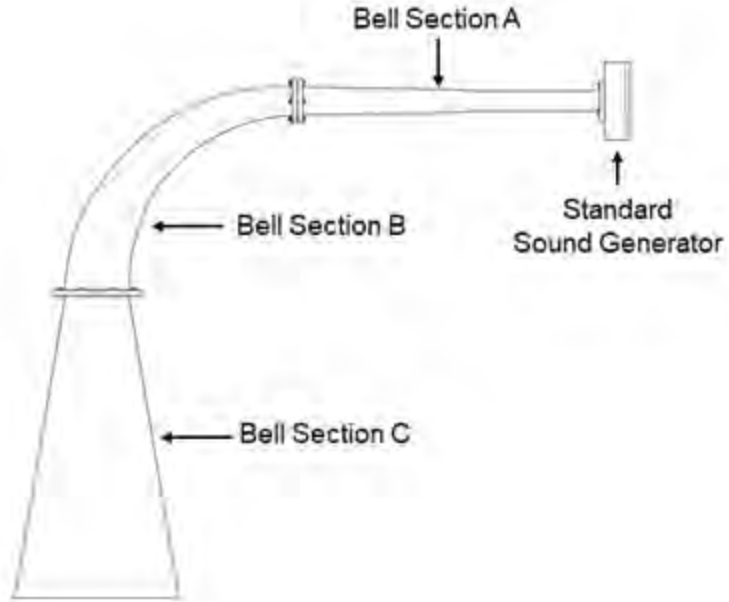


Dominion Mt. Storm Power Station
Original Online Catalyst Cleaning System

A total of forty-four (44) Model DC-75 Acoustic Cleaners were installed on all of the SCR Reactors.
8 Acoustic Cleaners for the LPA Screen & 36 Acoustic Cleaners for the Catalyst Layers

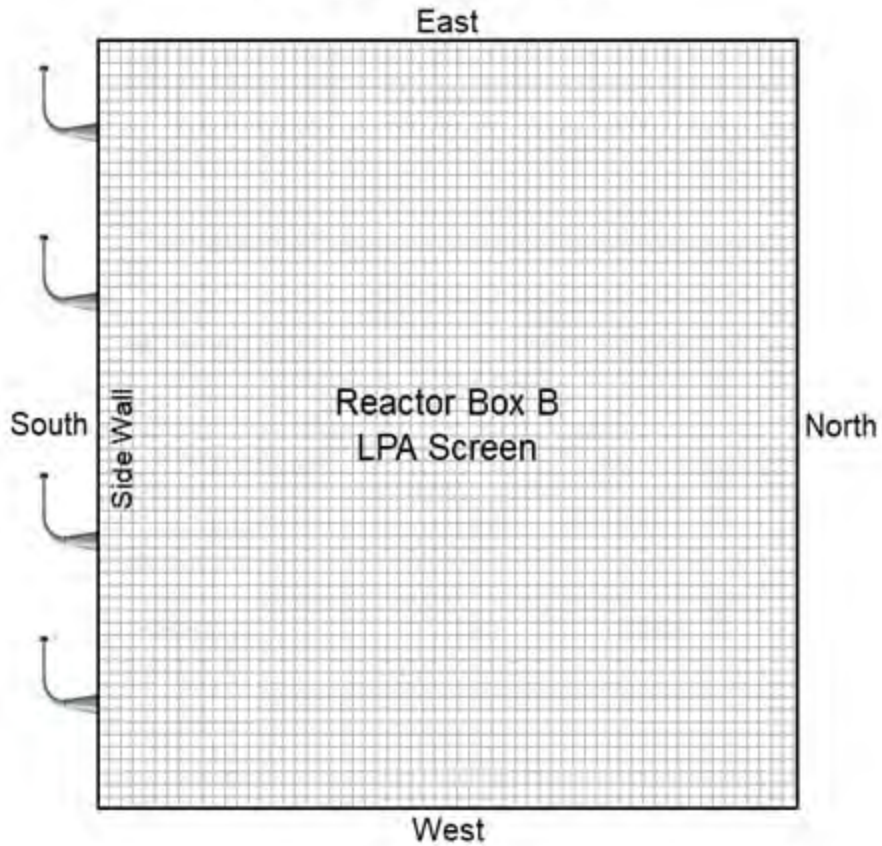
Model DC-75 Acoustic Cleaner

Power Weighted Mean Frequency: 160 Hz
(Frequency Range: 31.5 Hz to 315 Hz)
dB Output: 147 dB
Air Consumption: 70 SCFM @ 80 PSI

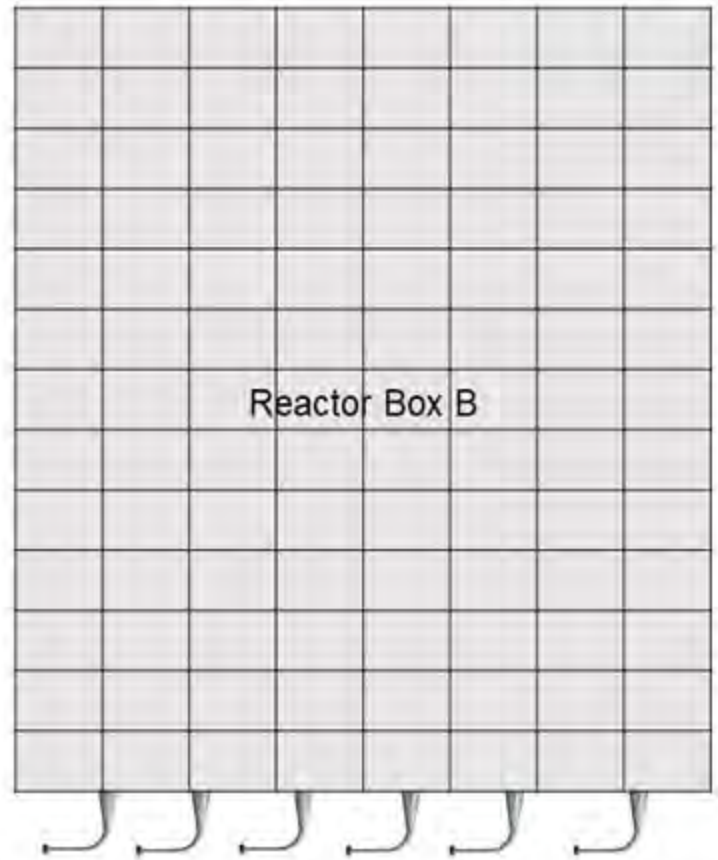


Dominion Mt. Storm Power Station
Unit 1 & 2 SCR Reactors

LPA Installation

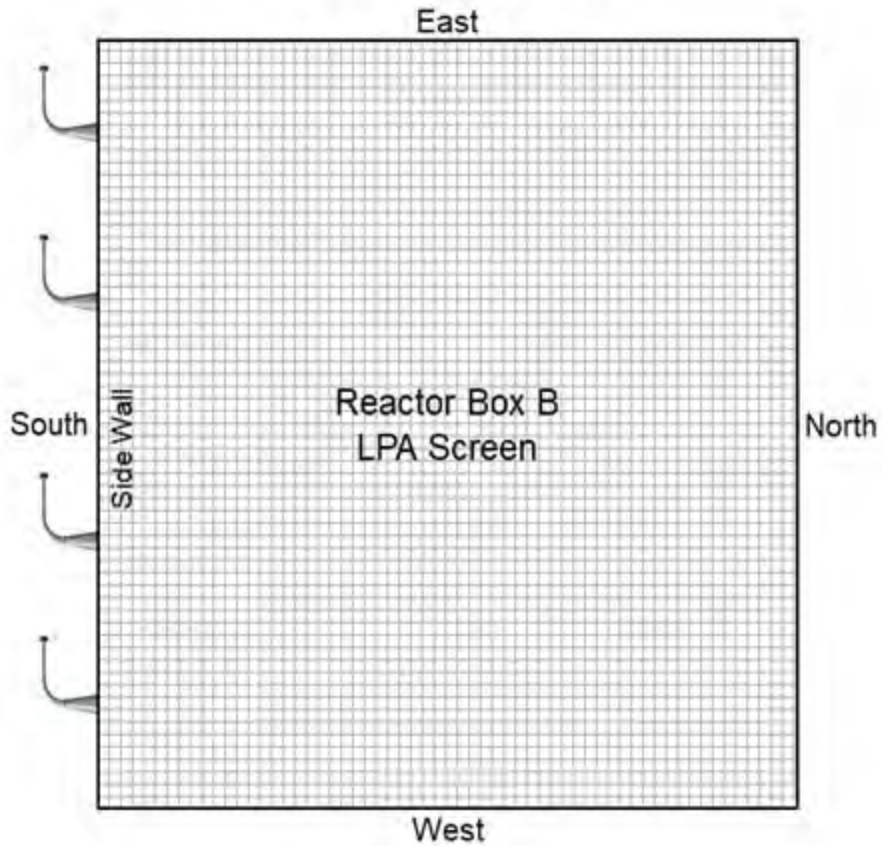


Catalyst Layer Installation (Per Layer)

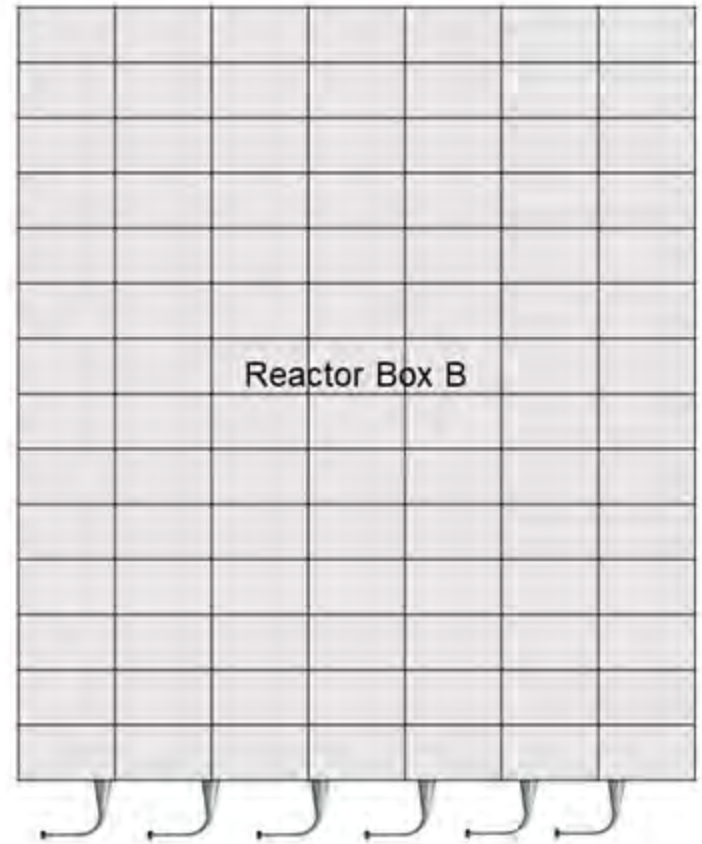


Dominion Mt. Storm Power Station
Unit 3 SCR Reactor

LPA Installation



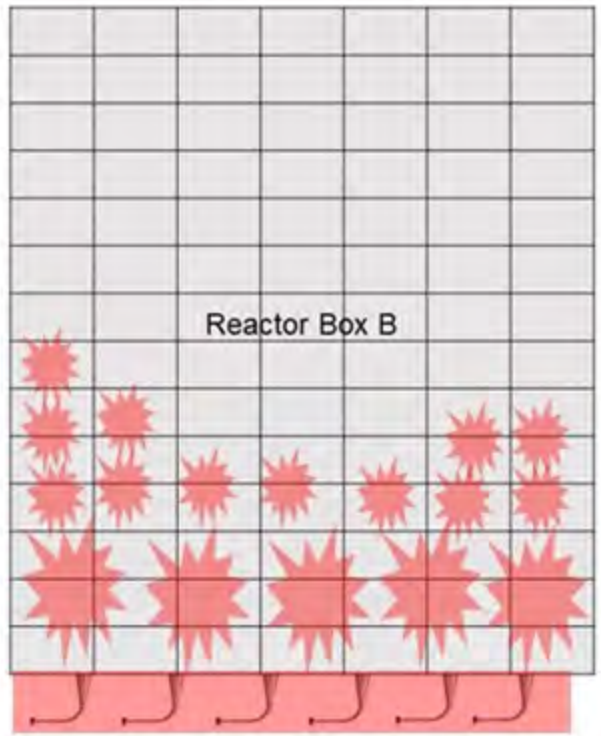
Catalyst Layer Installation (Per Layer)

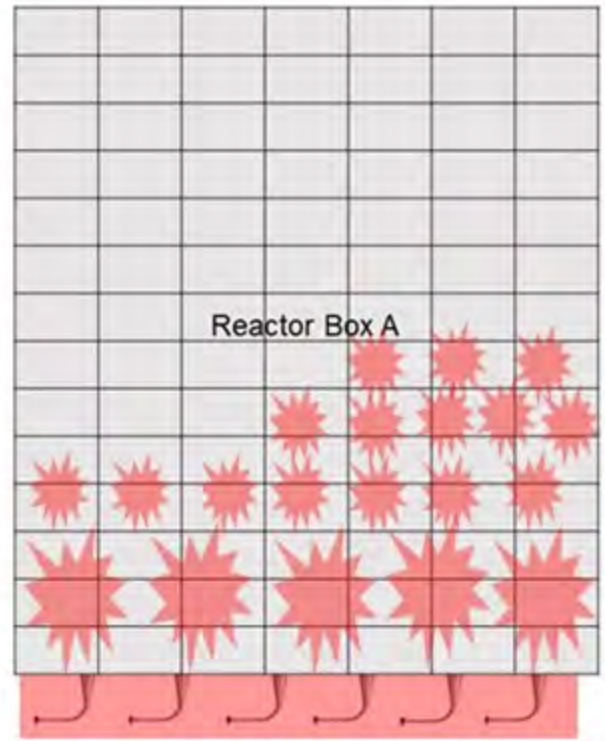


All of the SCR Reactors have had a History of Ash Piling

Unit 3 - 1ST Catalyst Layer – Inspected April/2014

The ash piles were vacuumed during the outage at great expense.





~ 36" Ash Pile

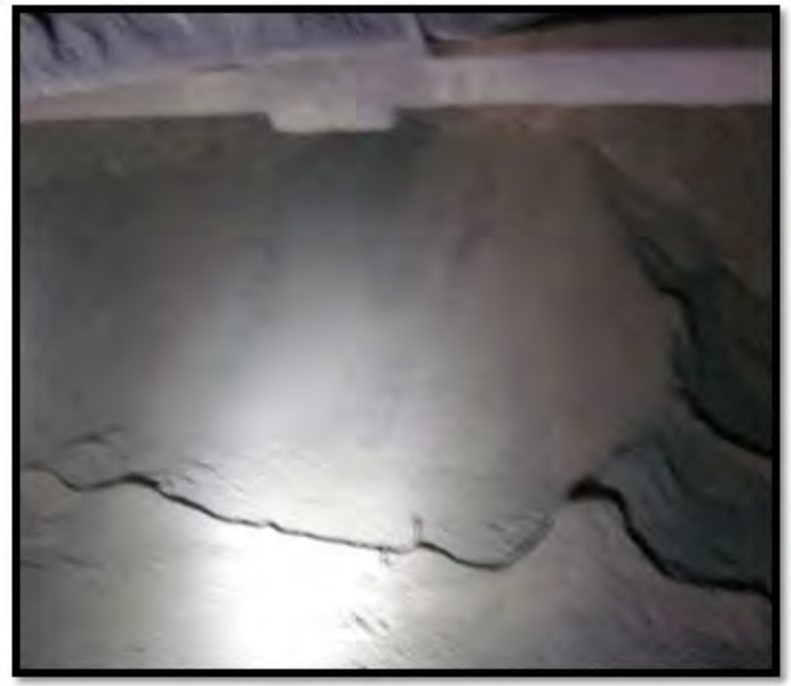
~ 72" Ash Pile

Plugged Acoustic Cleaners

All of the SCR Reactors have had a History of Ash Piling

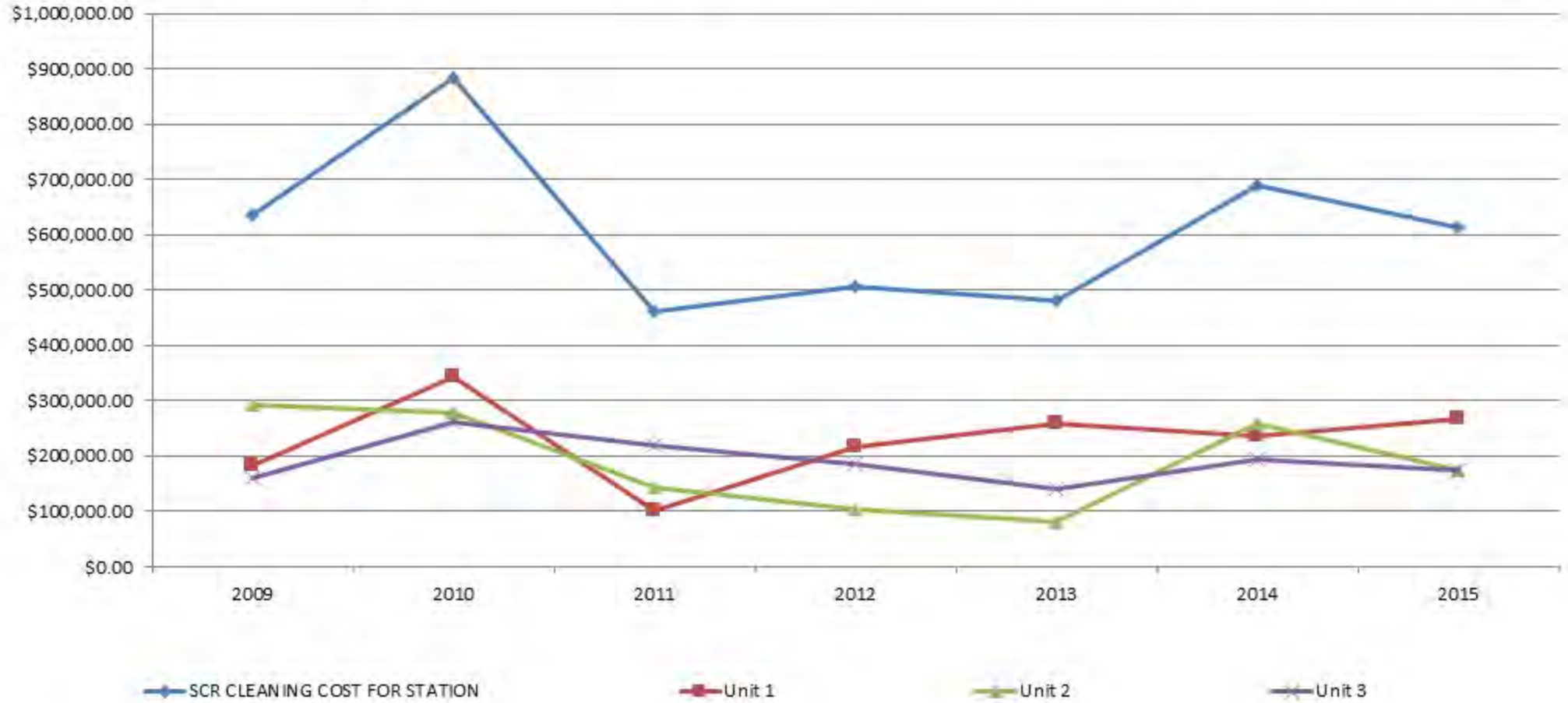
Unit 2 – 2nd Catalyst Layer
Ash Pile along the Front Wall

Unit 1 – 1st Catalyst Layer
Ash Pile along the Front Wall

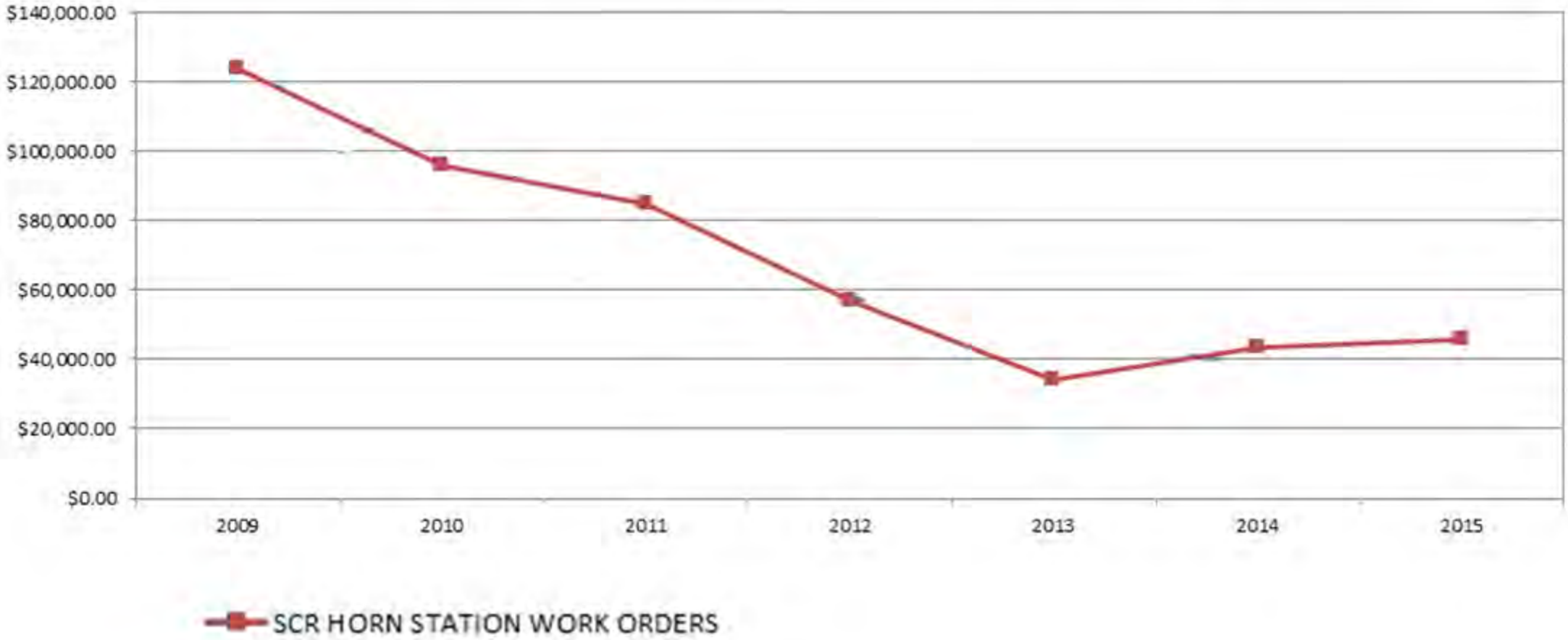


Unit 1 – 3rd Catalyst Layer
Ash Pile along the Rear Wall

From 2009 to 2015 the Mt. Storm Power Plant average spending ~$610,000.00 a year on off-line cleaning (vacuuming) of the Unit 1, Unit 2 and Unit 3 SCR Reactors.



From 2009 to 2015 the Mt. Storm Power Plant average spending $80,000.00 a year to maintain the 132 Model DC-75 Acoustic Cleaners installed on the Unit 1, Unit 2 and Unit 3 SCR Reactors.

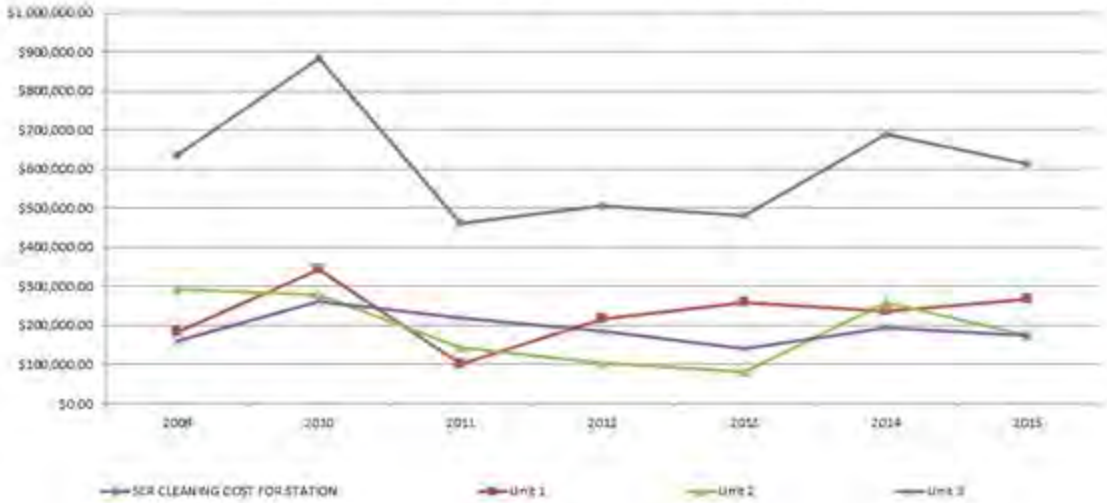


In 2016, plant personnel initiated a project to review the operation & upkeep of the Model DC-75 Acoustic Cleaners to determine what steps needed to be taken to improve the online cleaning of the catalyst modules.

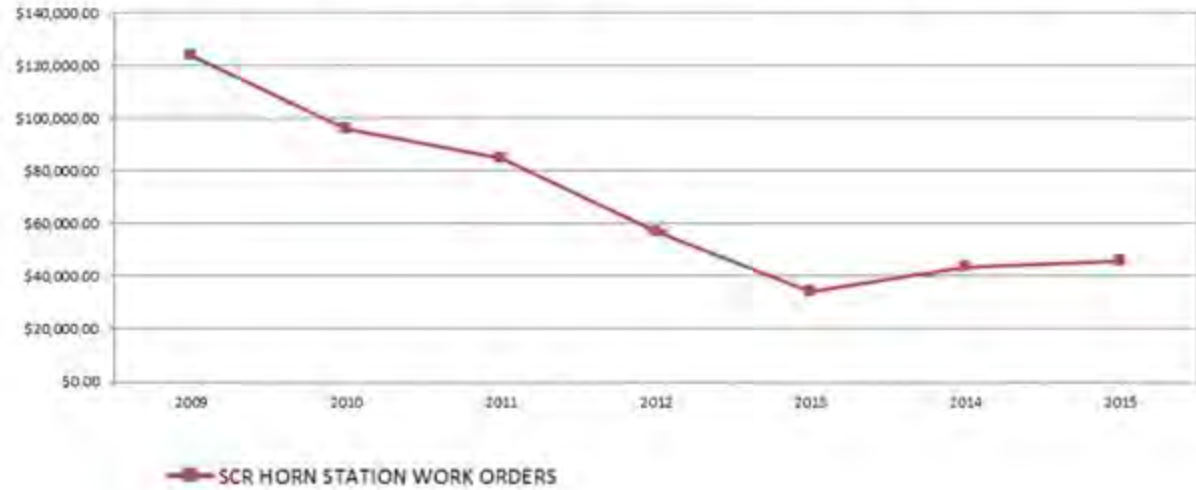
Project Goals

- Improve the Effectiveness of the Acoustic Cleaners
- Lower the Yearly Maintenance Cost on the Acoustic Cleaners
- Train Maintenance Personnel to Maintain the Acoustic Cleaners Correctly

Off-Line Cleaning Cost

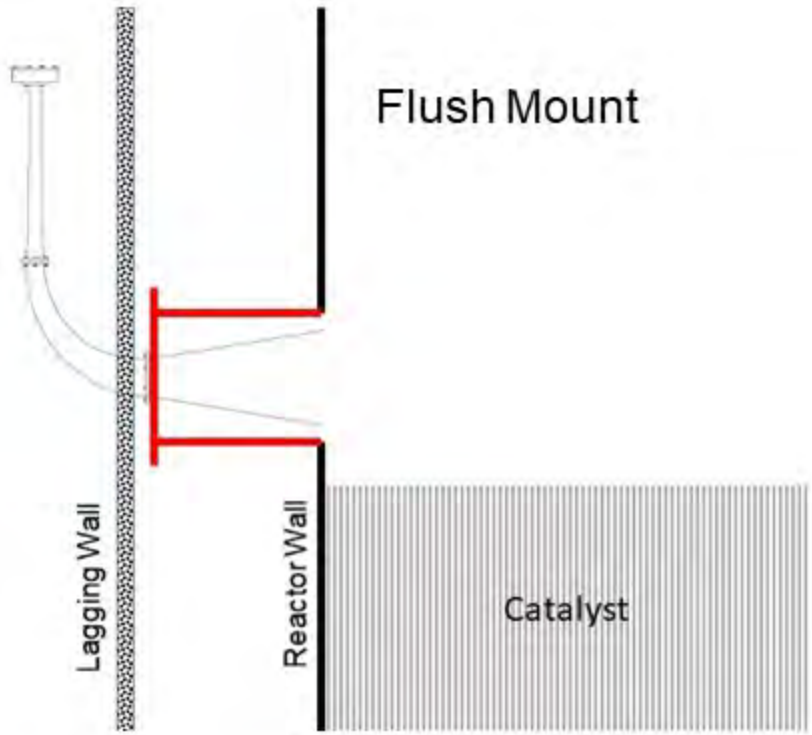


Acoustic Cleaner Maintenance Cost

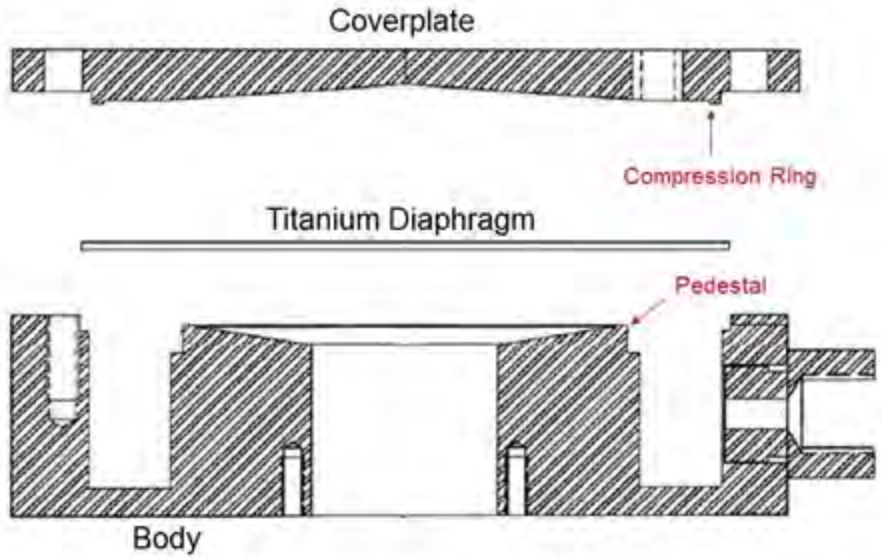


Plant personnel selected **Acoustic Cleaning Systems, Inc** to evaluate the installation and to make recommendations for optimizing the reliability/performance of the acoustic cleaners.

Catalyst Layer Installation



Maintenance Issue – Sound Generator



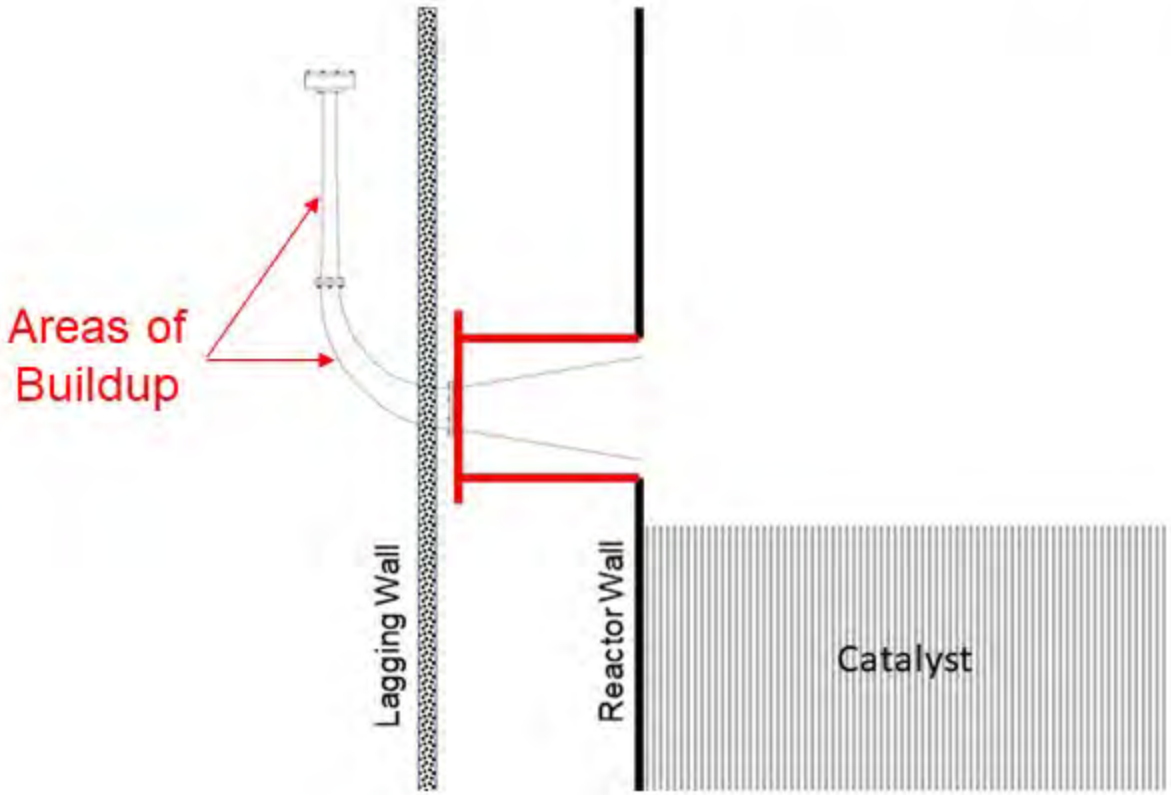
Body/Pedestal

After years of operation, the wear surfaces of the sound generator should be checked by using a depth micrometer. The wear surfaces are the compression ring on the coverplate and the pedestal on the body. The pictures on the right show how the depth micrometer can be used to check the tolerances of these surfaces. If the wear surfaces are found to be out of tolerance, the sound generator should be replaced.

Coverplate

Maintenance Issue – Bell Section

The main maintenance issue experienced on acoustic cleaners installed on SCR reactors is the growth of a hard crusty deposit in the ID of the bell sections protruding through the lagging. The deposits occur because the flue gas that backs up into the bell section is dropping below the acid dew point. The deposits in the bell sections interfere with the sound wave development.



Plugged Bell Section A

Maintenance Issue – Bell Section

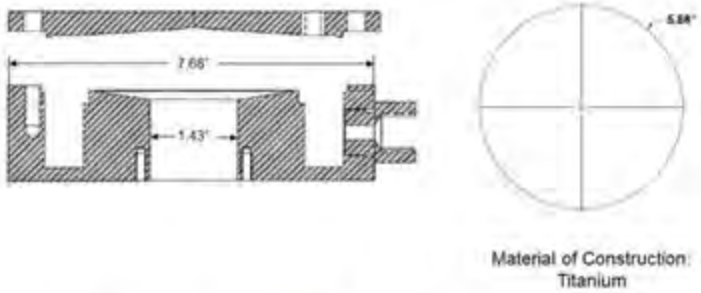
The Mt. Storm Power Plant insulated the bell sections that protruded through the lagging with a removable insulation blanket. This is common method of insulating the bell sections. The blankets **do not** prevent the flue gas inside the bell sections from dropping below the acid dew point.

The pictures above are of corroded bell sections.

ACS Recommendations:

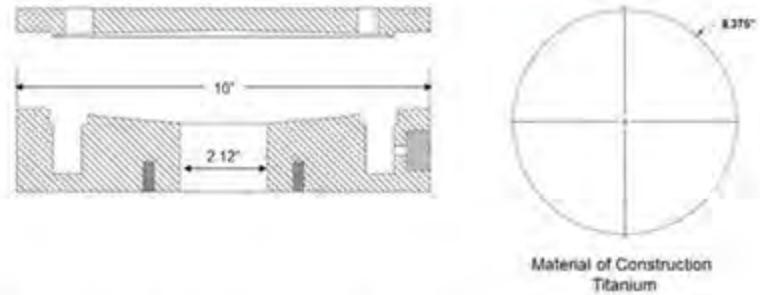
#1: Replace the existing Sound Generators with Magnum Sound Generators

Standard Sound Generator



Material of Construction:
Titanium

Magnum Sound Generator



Material of Construction
Titanium

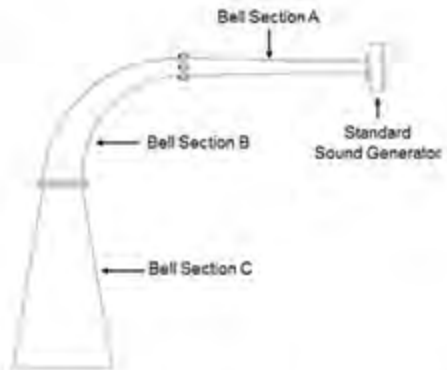
The air requirements for the Standard Sound Generator and the Magnum Sound Generator are identical.

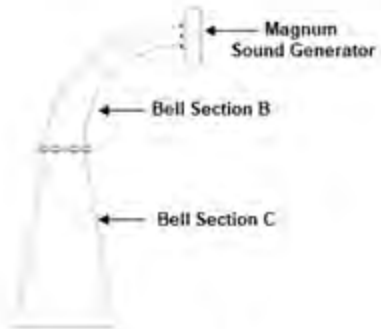
Air Pressure: 70 – 90 PSI **Air Consumption: 60 - 80 SCFM**

Advantages of the Magnum Sound Generator:

#1: Elimination of Plugged/Corroded Bell Section A

#2: Replacing Standard Sound Generator (The majority of the sound generators were out of tolerance.)





#3: Improving the Cleaning Capabilities of the Acoustic Cleaners

The acoustic energy emitted from the acoustic cleaner fitted with the Magnum Sound Generator causes greater particle displacement. This is accomplished because the Magnum Sound Generator is more effective and efficient at producing acoustic energy in the lower frequency bands, 31.5 Hz to 315 Hz.

See the next slide for the videos showing the cleaning differences.

Standard 75 Hz Acoustic Cleaner
Distance: 30’

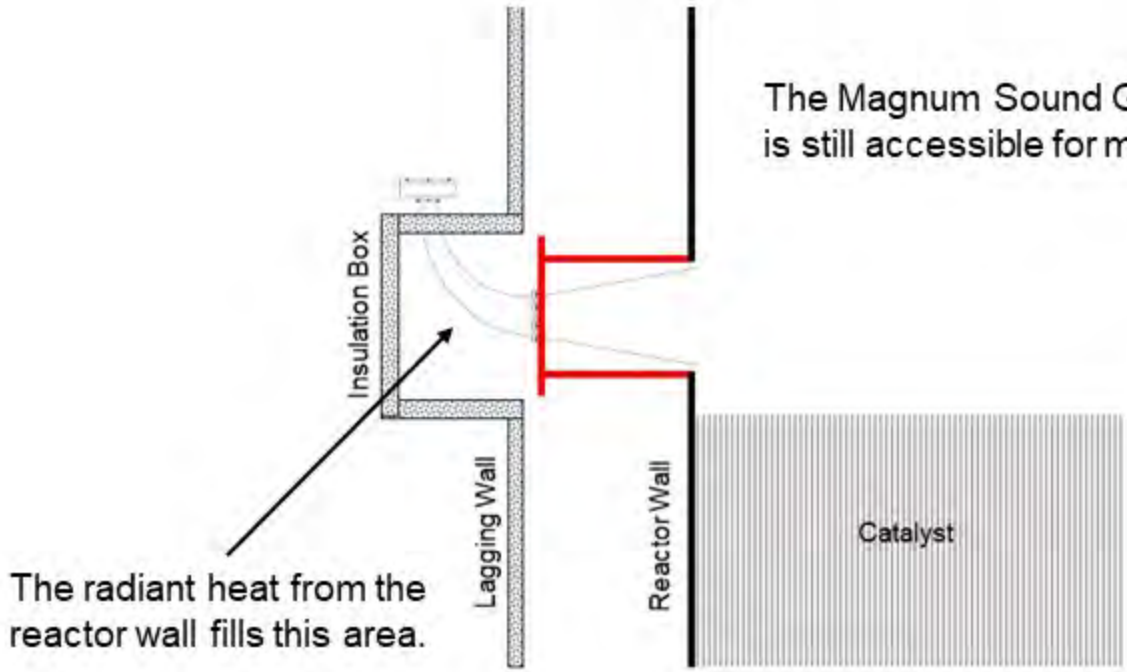
Magnum Acoustic Cleaner
Distance: 30’

These videos can be see on the Acoustic Cleaning Systems, Inc. website at www.acousticcleaning.com or on YouTube - https://www.youtube.com/watch?v=y1JirO3Rb5c

ACS Recommendations:

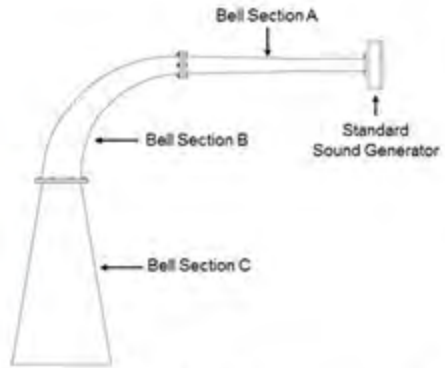
#2: Insulate the Acoustic Cleaners Correctly

When properly insulated, the flue gas that backs into the bell sections of the acoustic cleaners will not drop below the acid dew point. This eliminate the issues of bell pluggage and bell corrosion.

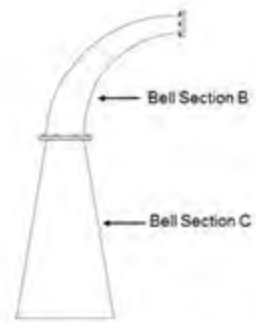


The Magnum Sound Generator is still accessible for maintenance.

Retrofitting the Model DC-75 Acoustic Cleaners with the Magnum Sound Generator

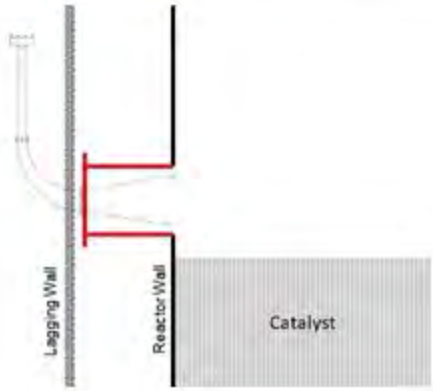


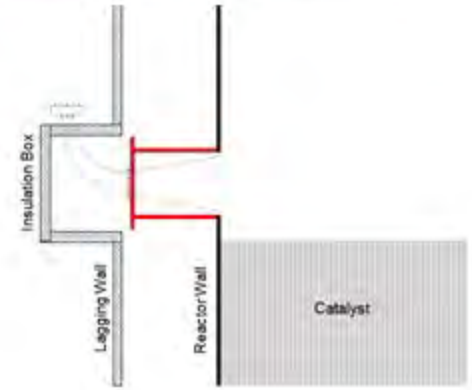
Model DC-75
Acoustic Cleaner



Remove Bell Section A &
Standard Sound Generator

Install
Magnum Sound Generator





Picture 1
Model DC-75 Acoustic Cleaner Installation

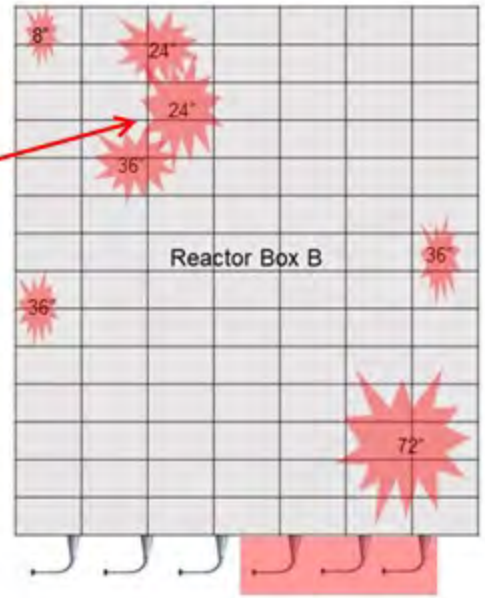
Picture 2
Bell Section A & Standard Sound Generator
are replaced with the Magnum Sound Generator

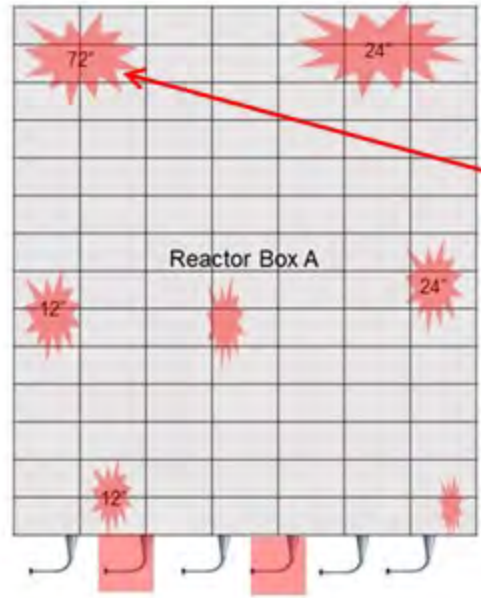
Picture 3
Lagging & Insulation Removed from Reactor Wall

Picture 4
Insulation Box is installed around Bell Section B

Unit 3 - 1ST Catalyst Layer – Inspected on 09/2016

Ash buildup on the 1st Catalyst Layer prior to upgrading the Acoustic Cleaners

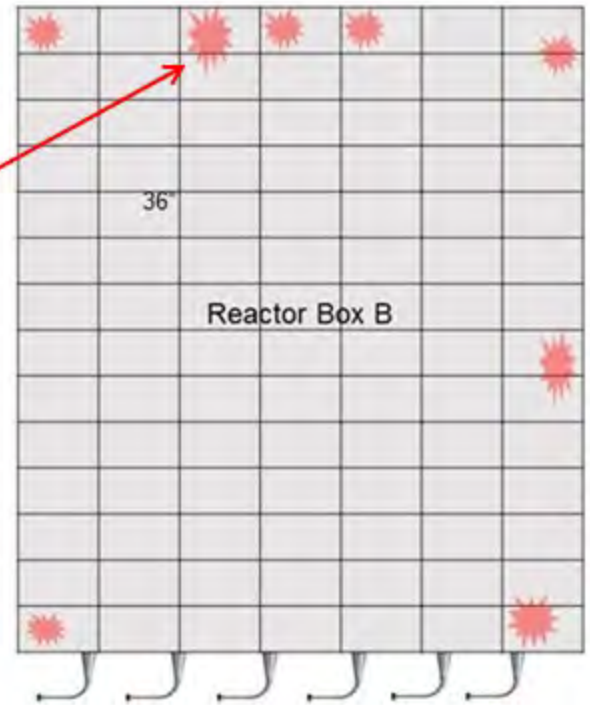


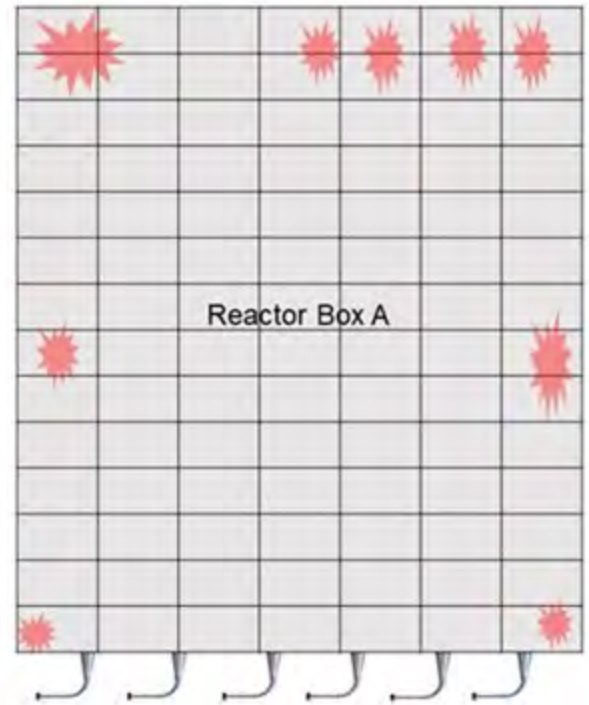


Plugged
Acoustic Cleaners

Unit 3 - 1ST Catalyst Layer – Inspected on 10/2017

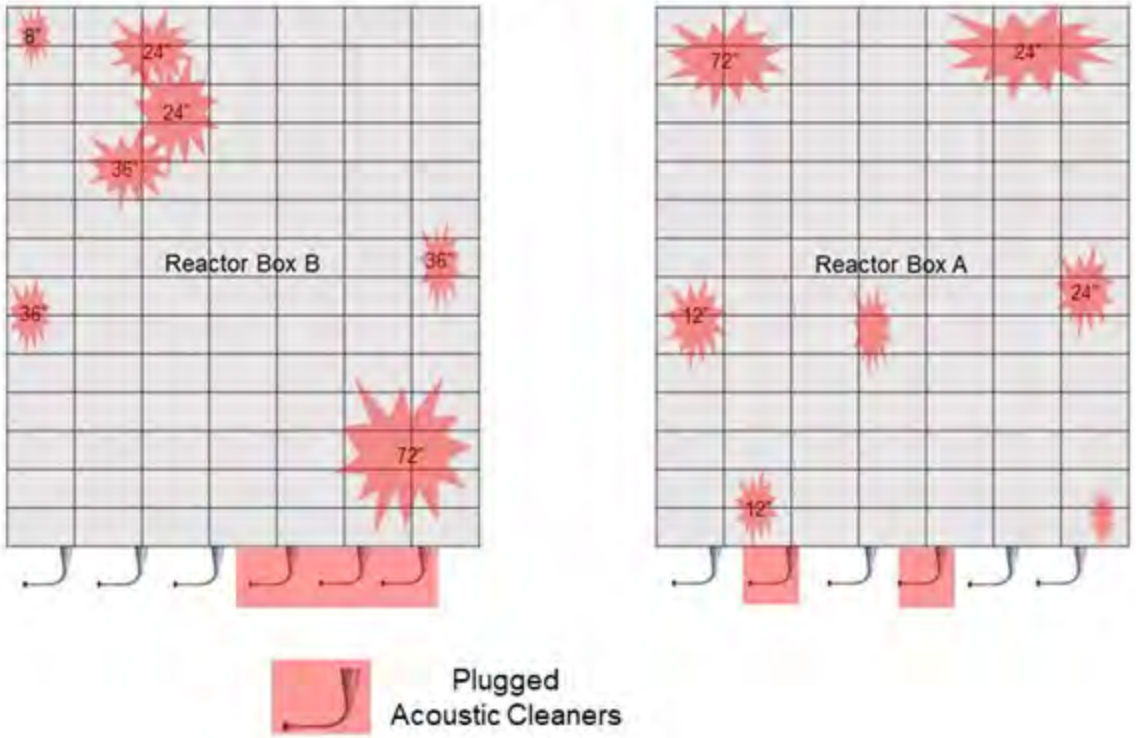
Ash buildup on the 1st Catalyst Layer after upgrading the Acoustic Cleaners





Unit 3 - 1ST Catalyst Layer – Inspected on 09/2016

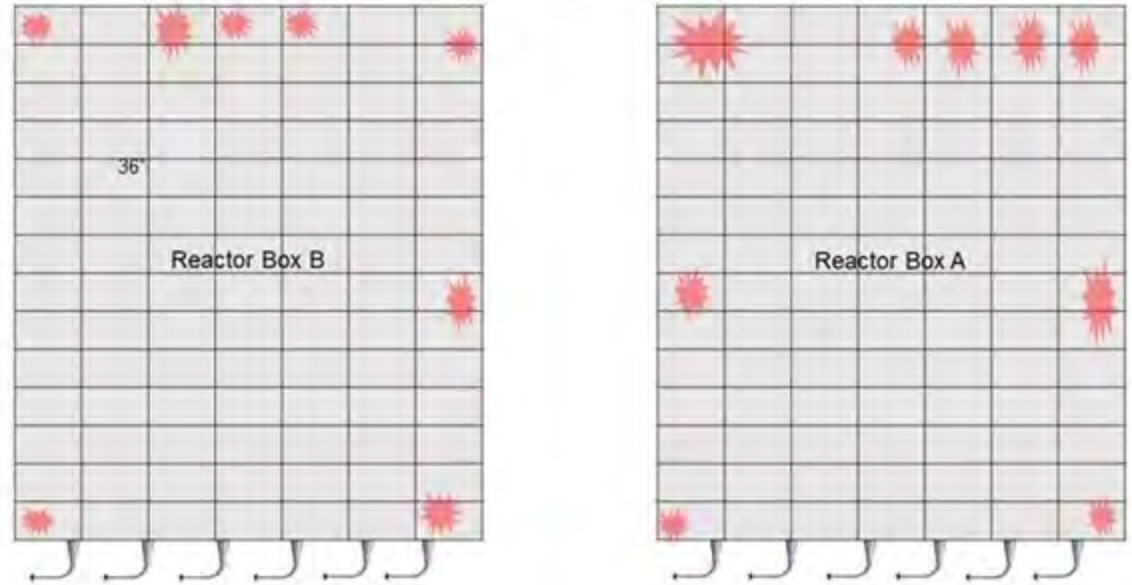
Ash buildup on the 1st Catalyst Layer
prior to upgrading the Acoustic Cleaners



Plugged
Acoustic Cleaners

Unit 3 - 1ST Catalyst Layer – Inspected on 10/2017

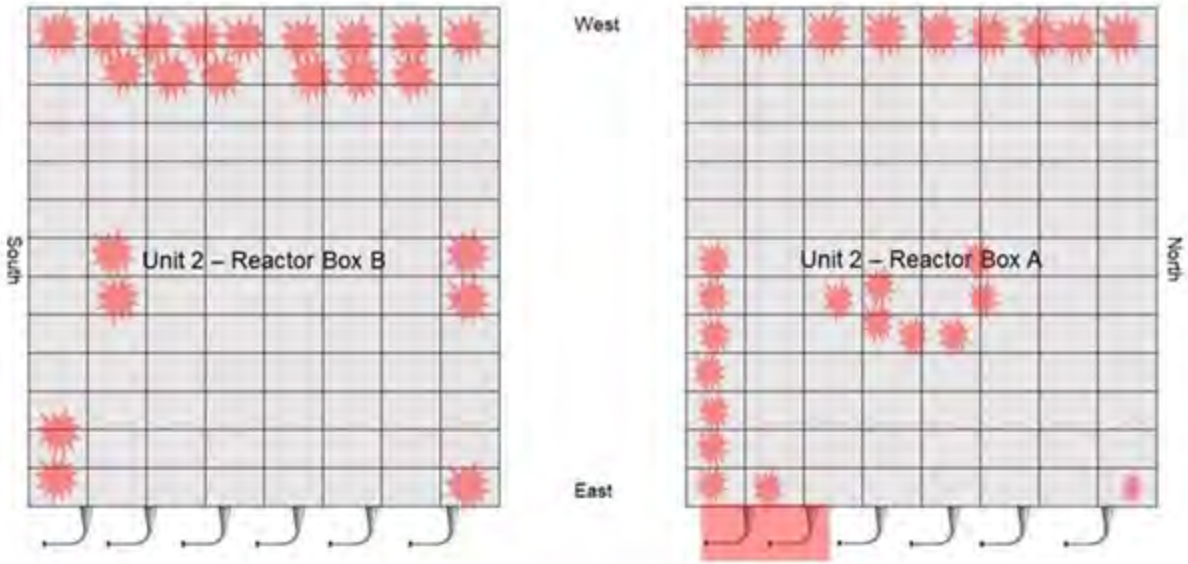
Ash buildup on the 1st Catalyst Layer
after upgrading the Acoustic Cleaners



No Plugged
Acoustic Cleaners

Unit 2 - 1ST Catalyst Layer – Inspected Spring

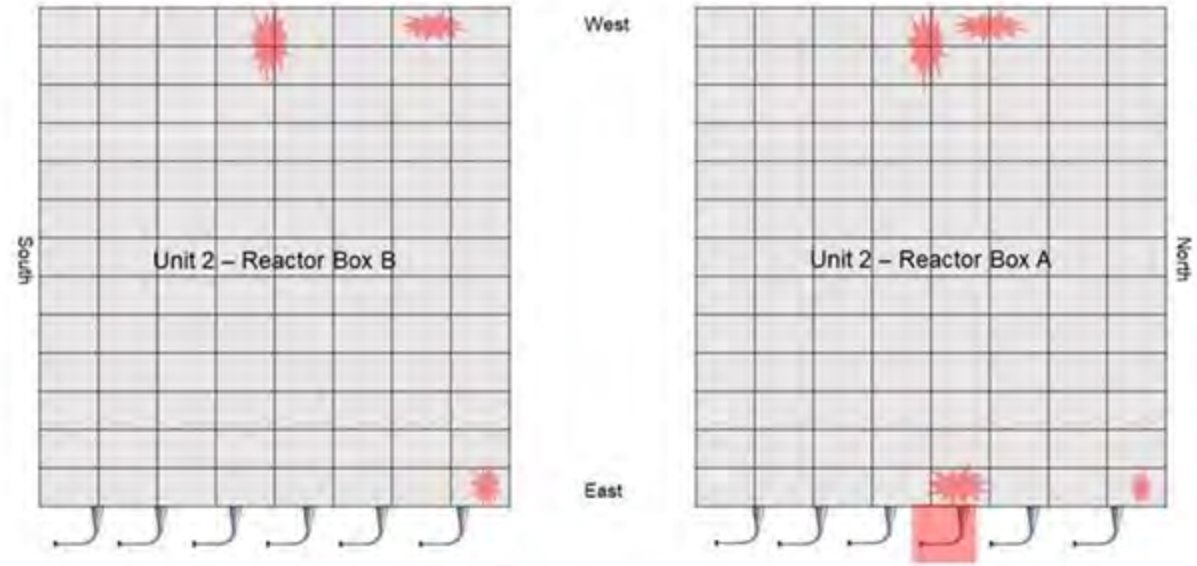
Ash buildup on the 1st Catalyst Layer
prior to upgrading the Acoustic Cleaners



Plugged
Acoustic Cleaners

Unit 2 - 1ST Catalyst Layer – Inspected on Fall

Ash buildup on the 1st Catalyst Layer
after upgrading the Acoustic Cleaners



Plugged
Acoustic Cleaners

"6 MONTHS
BETWEEN OUTAGES"

Mt. Storm Power Station - Magnum Upgrade Projects

Unit 1 SCR Reactor – Fall of 2016

Unit 2 SCR Reactor – Spring of 2017

Unit 3 SCR Reactor – Spring of 2016

Acoustic Cleaner Maintenance Cost

In 2017, the plant spent $14,055.00 on replacement parts for the Magnum Sound Generators. The majority of these components were purchased to be put into inventory for future spare parts. This is a **$65,000.00 reduction** in the average amount spent to maintain the acoustic cleaners from 2009 to 2015.

Off-Line Catalyst Cleaning Cost

In 2017, the plant spent less than $300,000.00 dollars vacuuming the SCR reactors. The majority of this cost was to vacuum the Unit 2 SCR reactor. The acoustic cleaners installed on the Unit 2 SCR reactor were not yet upgraded with the Magnum Sound Generators. This still was a **$310,000.00 reduction** in the average amount spent to vacuum the reactors from 2009 to 2015.

Total Savings in 2017: $375,000.00

Reinhold Environmental Ltd.

Additional Benefits with Cleaner Catalyst Modules

- Increased DeNOx Potential
- Increased Catalyst Life
  (Less Pluggage = Less Erosion = Increased Catalyst Life)
- Increased Mercury Oxidation
- Decreased Ammonia Usage & Slip
- Decreased Pressure Drop
- Decreased ID Fan Power Consumption

Questions?

BEFORE

"9 MONTHS
BETWEEN OUTAGES"

After