

# Reinhold Environmental Ltd.

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2009 NO<sub>x</sub>-Combustion Round  
Table & Expo Presentation

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February 9 & 10, 2009, Cleveland, OH

# 2009 NOx-Combustion Round Table

## Pulsed Detonation Applications for Boiler Cleaning & Efficiency Improvements

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GE Energy



imagination at work



# Sootblowers – A Necessary Evil

Conventional sootblowers are mechanical devices for discharging air, steam or water to clean heat absorbing surfaces.



Sootblowers are expensive to operate, expensive to maintain,  
and erosive to the boiler tubes.

Electric Power Institute  
“Tube Repair and Protection from Damage  
Caused by Sootblower Erosion”  
10080837 March 2004

- The number one cause of forced outages in fossil plants today is boiler tube failures. Responsible for an estimate 6% loss of unit availability.
- 23% of the total tube failures reported were due to sootblower or flyash erosion.
- Extending time between major outages is resulting in more forced outages due to tube failures.

# Pulse Detonation

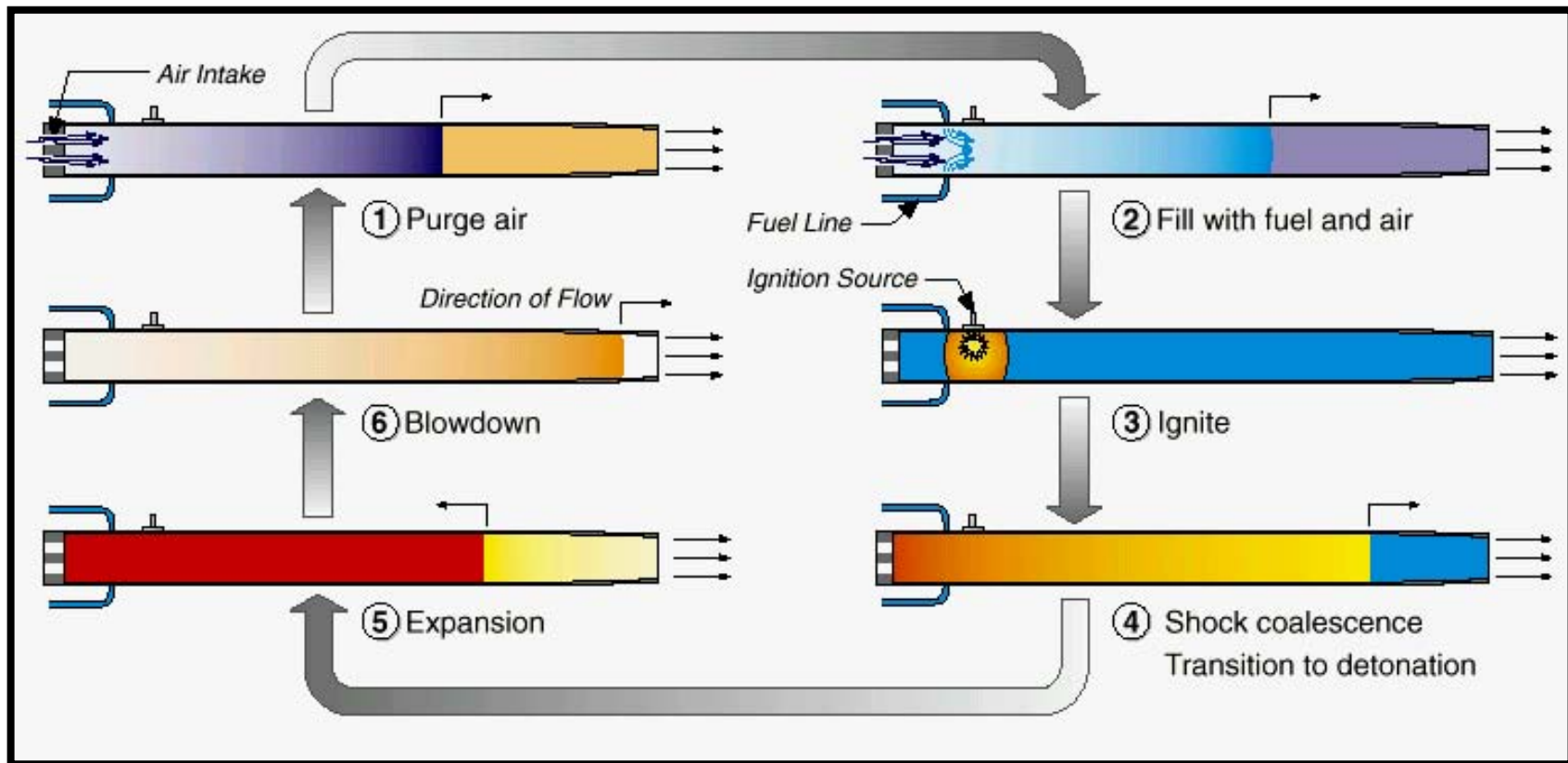


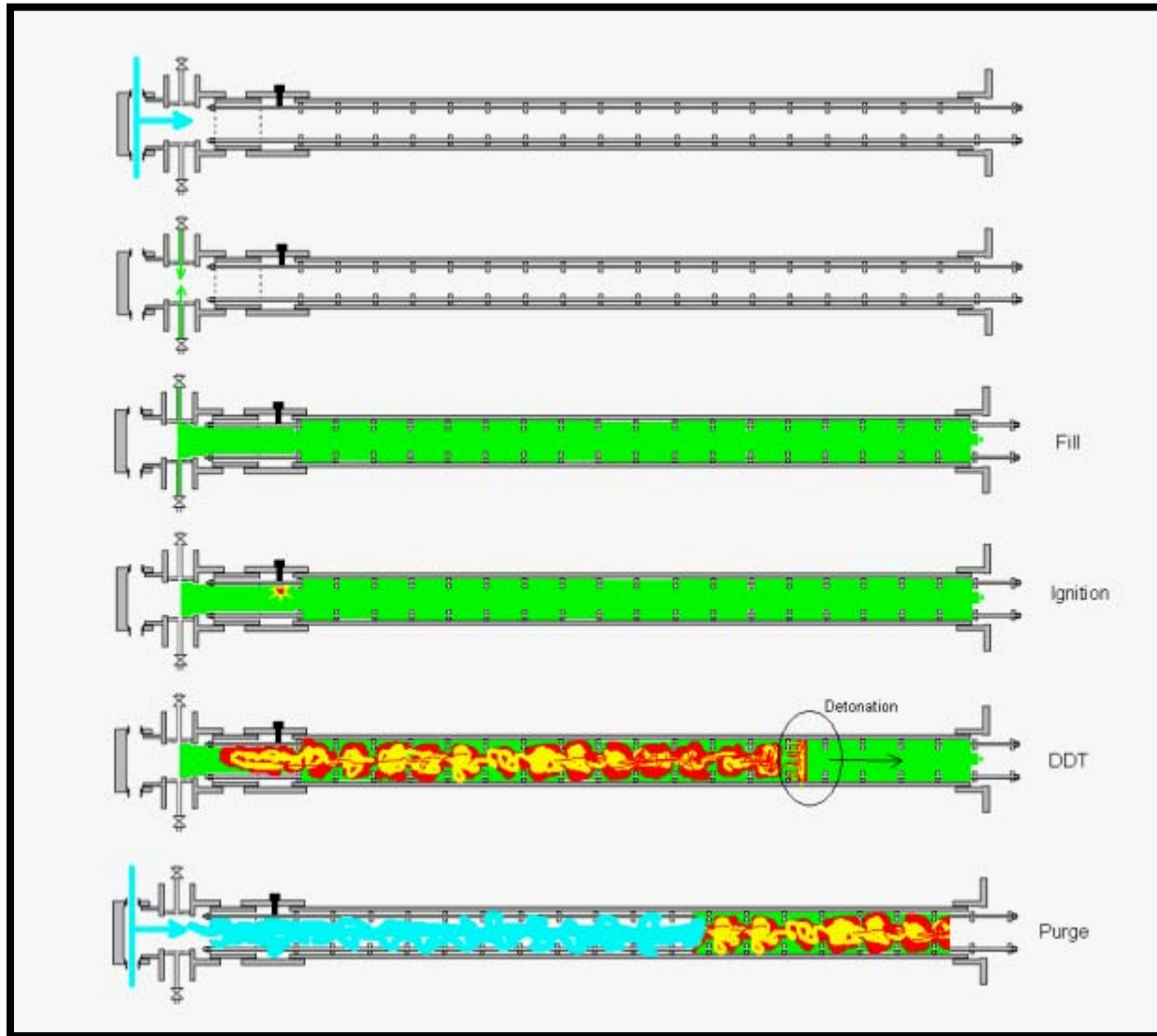
## How Does Pulse Detonation Technology Work?

Using technology developed for the future of jet propulsion, the PowerWave)))Plus creates impulses in a controlled, pulsed manner in order to direct cleaning waves at the collective surfaces.

The impulse wave penetrates in and around obstructions it encounters, providing more complete surface contact. The result of this controlled process is a much cleaner boiler with optimized heat exchange and increased performance.

A cleaning cycle is the result of a complex process that is managed entirely by a fully automated, simple to use control system. Each burst consists of precise delivery of fuel and air to the combustion chamber followed by ignition of this mixture and acceleration from subsonic to supersonic mach-5 speeds. The supersonic impulse exits the bell into the area of the boiler to be cleaned.





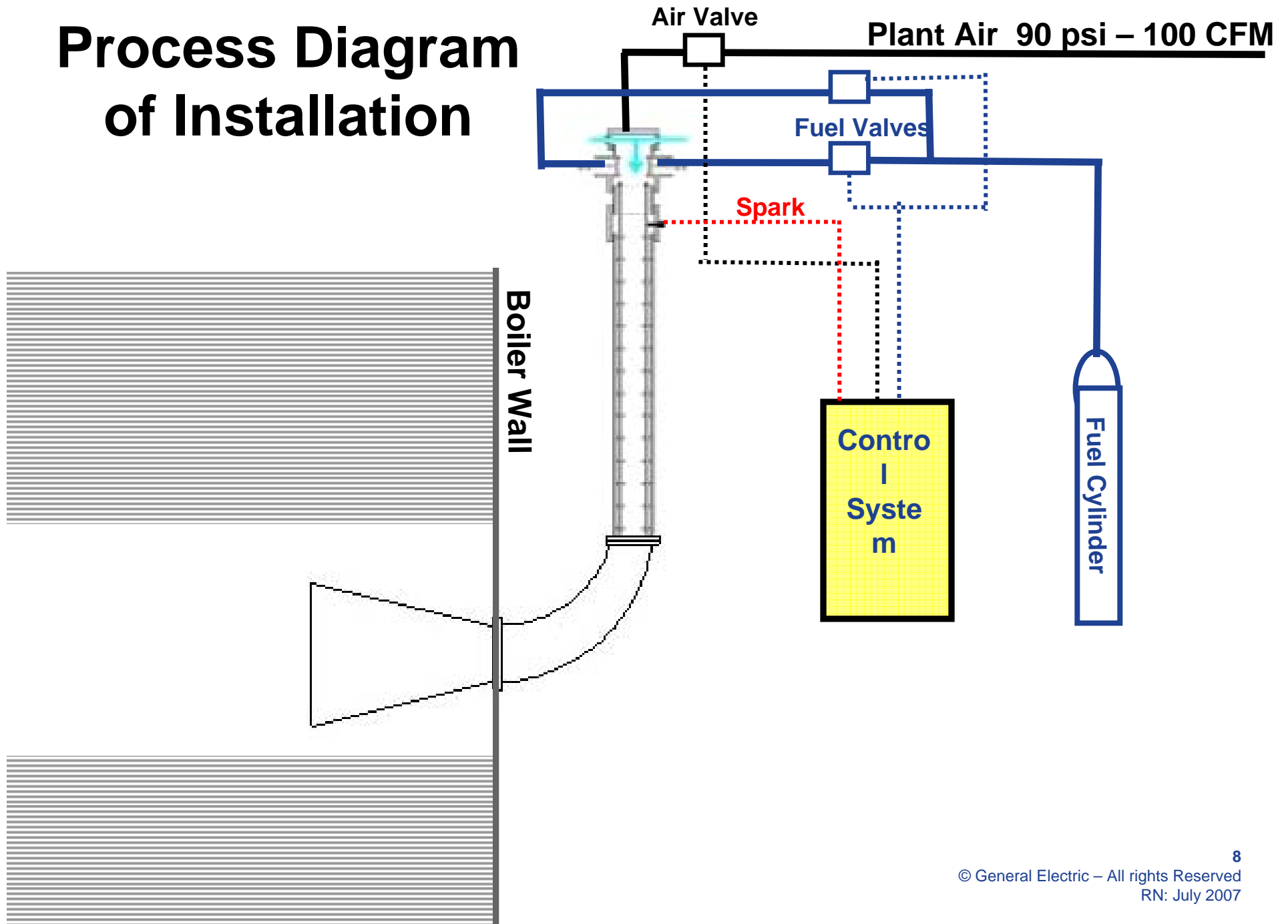
# Facility Requirements

- Electrical: 110 VAC
- Air: ~80-100 SCFM (90 psi),
- Fuel: Ethylene Gas (C<sub>2</sub>H<sub>4</sub>)

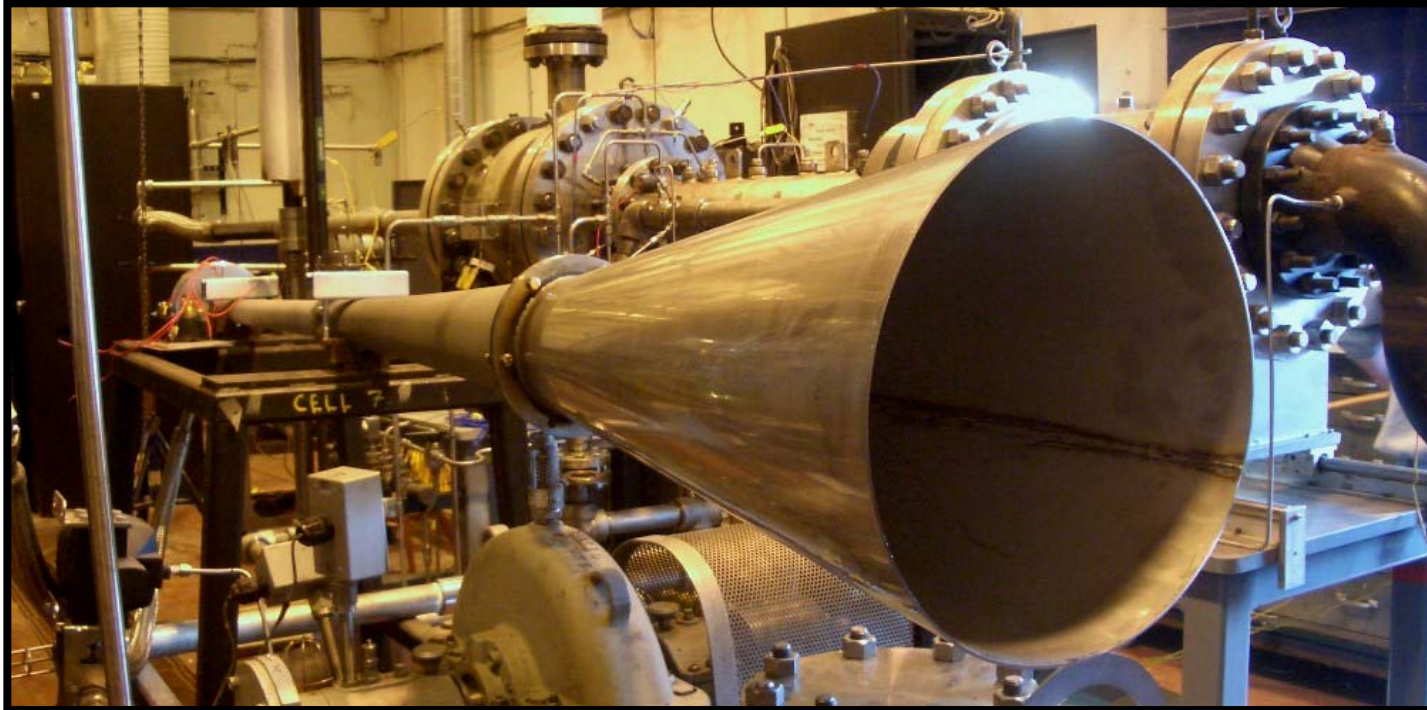


imagination at work

# Process Diagram of Installation



# Cleaning Technology Comparison



Lab and field testing has shown that the output from a PowerWave Plus is orders of magnitude greater than the leading acoustic cleaning technology

# Benefits of Impulse Cleaning

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- High energy impulse waves
- Multi-directional penetration of impulse wave
- Non-line of site cleaning
- Deeper penetration of the tube bank with the pressure waves
- Size allows for multiple installation points with minimal intrusion
- Online, Pro-active cleaning method

## **-Improved Cleaning-**

**The impulse wave emitted by a pulse detonation system will totally engulf the tube surfaces, cleaning the leading & trailing sides equally well.**

**This results  
in the elimination of shadow effects often  
experienced  
when cleaning with conventional sootblowers.**

## **-Improved Boiler Emissions-**

**The pro-active cleaning cycles used by a pulse detonation system eliminates or greatly reduces opacity spikes experienced during the cleaning of the heat transfer surfaces. As compared to the infrequent cleaning cycles**

**used by conventional sootblowers that entrain large amounts of ash and/or soot**

**deposits into the flue gas stream that can result in excessive opacity spikes**

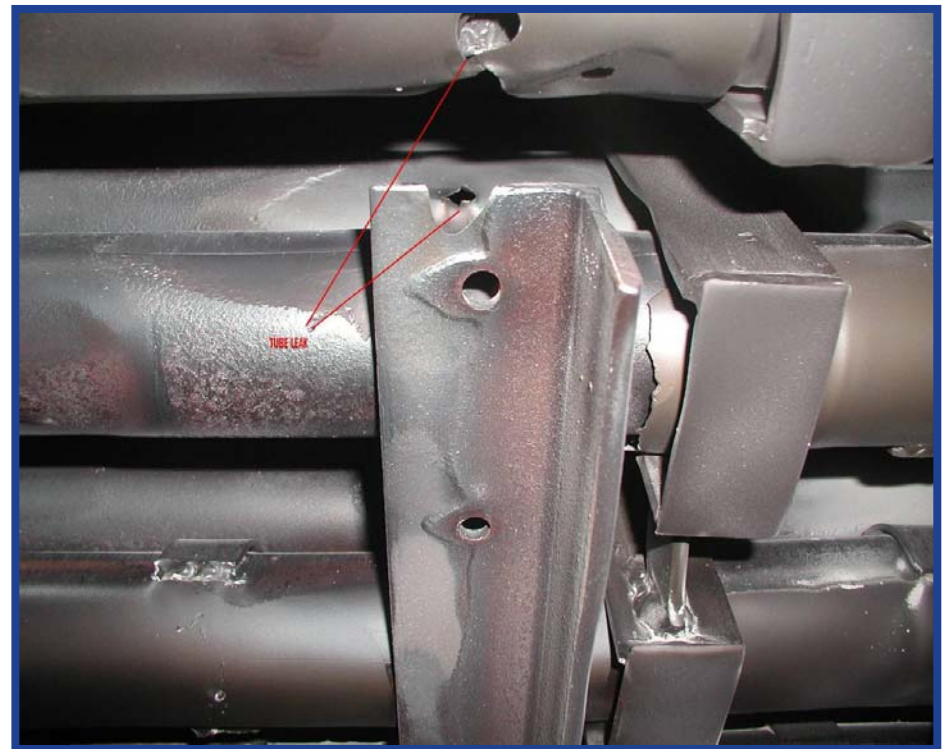


Information only

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RN: July 2007

# -Improved Life for the Heat Transfer Surfaces-

**Unlike conventional sootblowers, the cleaning actions of a pulse detonation system is not erosive to the heat transfer surfaces.**



**Tube Erosion Caused by Steam Sootblowers**

# Pulse Detonation Applications



**Air Preheaters**

**Convection Section**

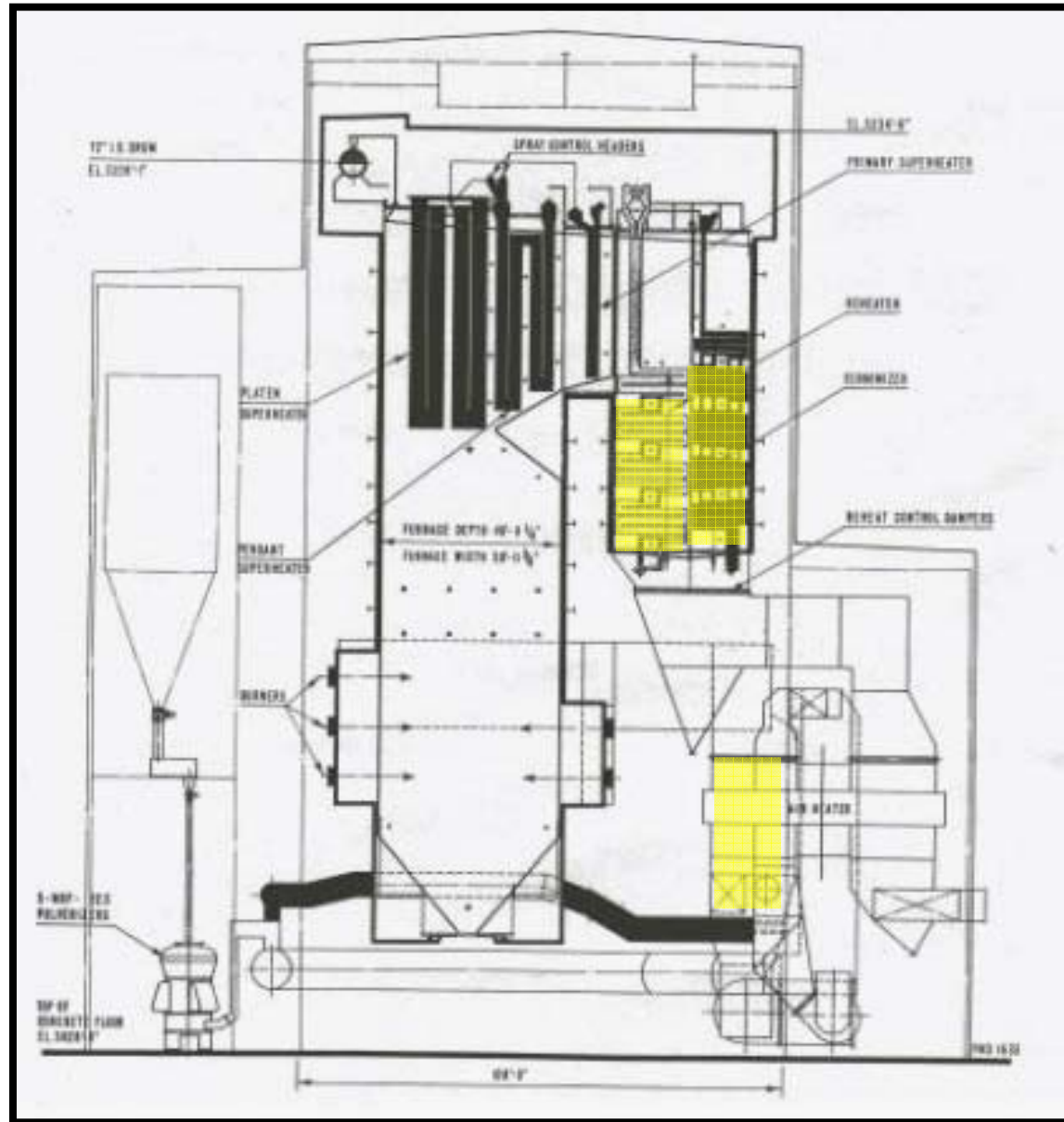
**Economizers**

**Precipitators**

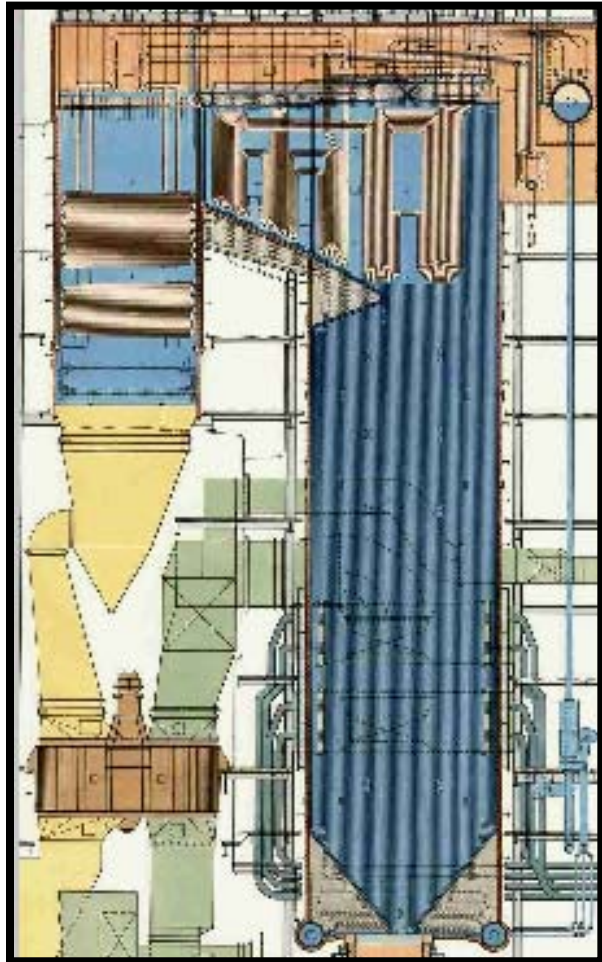
**SCR Reactors**

# Pulse Detonation Applications

The areas shaded in the yellow are viable regions to be cleaned by this technology!



# FirstEnergy – Ashtabula Plant



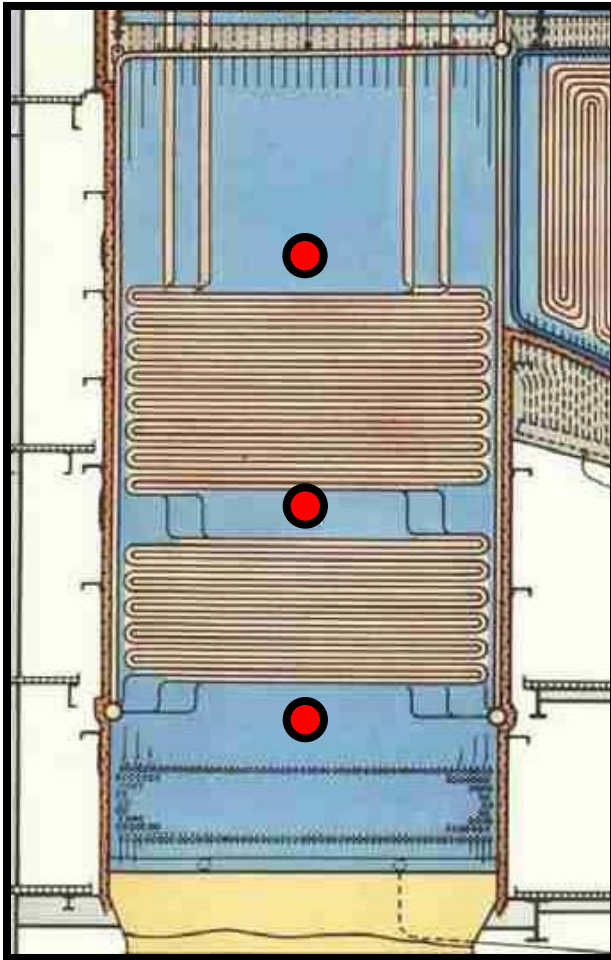
Unit 5 Boiler  
256 MW CE Boiler, Twin Furnace

Design to Burn Eastern  
Bituminous Coal

Switched to PRB Coal  
This lead to platenization & pluggage  
in the back passes of the boiler.

Economizer  
Staggered Fin-tube Arrangement

# FirstEnergy – Ashtabula Plant



Six (6) PowerWave)))Plus Impulse Cleaning Systems purchased and installed in March 2007

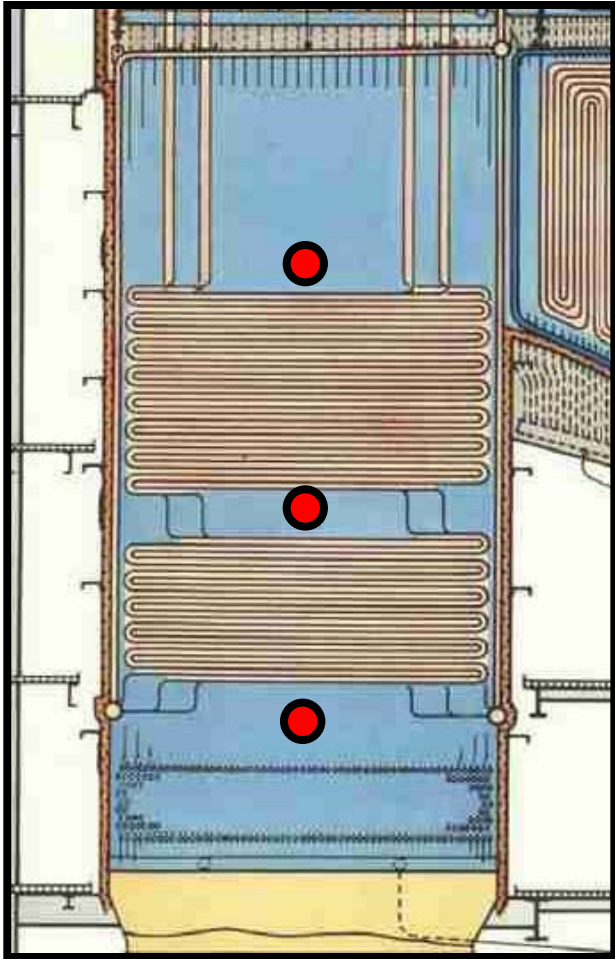
Two units installed above the Upper LTSH

Two units installed above the Lower LTSH

Two units installed above the Economizers

**● PowerWave)))Plus  
Impulse Cleaning Systems**

# FirstEnergy – Ashtabula Plant



Units cycled from top down

Each units operates every 1 hour

Each cleaning cycle is 10 seconds long



## PowerWave))) Plus Access Door Installation



# FirstEnergy – Ashtabula Plant



**This picture shows the build up of ash experienced on top of the economizer tube bank once the boiler started burning PRB coals.**



**This picture shows the lack build up of ash experienced on top of the economizer tube bank since the installation of the PowerWave)))Plus Impulse Cleaning Systems.**

# Long Term Results

This data represents a full year of operation of PowerWave)))Plus Systems the on the Unit 5 Boiler as compared to the year prior to installation.

33° F decrease in Economizer Outlet Gas Temp

>25 ° F decrease in APH outlet Temp

30% improvement in APH delta P

Noted improvement in ESP collection efficiency

No unplanned outages due to fouling in backpass

Internal Inspections showed boiler maintaining cleanliness