Industrial Boiler MACT HCL/PM Control with Wet Scrubbing / Wet ESP Control Technology

Buzz Reynolds VP Wet ESP
Siemens Environmental Systems & Services
Industrial Boiler NESHAP Rule

- Issued: January 31, 2013

- Compliance by:
  - Existing Units = January 31, 2016 with 1 year extension possible
  - New Units = January 31, 2013 or upon start-up (commenced construction after 6/4/10)

- Controls: HCL, Hg, PM, CO
Dry Technologies for HCL, Hg, PM Control

- Duct Injection
- Spray Dryer Absorber Systems
- Circulating Dry Scrubber
- Fabric Filters
- Dry ESPs
**Conventional Wisdom = DSI+ PAC + Fabric Filter**

- **BOILER**
- **AIR PREHEATER**
- **SCR**
- **DRY ESP**
- **ESP**
- **Fabric Filter**

**Hydrated Lime Injection**

**Powdered Activated Carbon for Hg**
## Issues with DSI / PAC / FF Controls

<table>
<thead>
<tr>
<th>Fabric Filter</th>
<th>DSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased pressure drop</td>
<td>Increased PM loading</td>
</tr>
<tr>
<td>• may require new larger fans</td>
<td>• does DESP have capacity</td>
</tr>
<tr>
<td>More real estate for FF</td>
<td>Increased maintenance</td>
</tr>
<tr>
<td>• is there enough room</td>
<td>• plugging issues</td>
</tr>
<tr>
<td>On-going bag replacement</td>
<td>Increased operating costs</td>
</tr>
<tr>
<td>• cost + outage time</td>
<td>on-going sorbent injection</td>
</tr>
<tr>
<td>Increased waste by-product</td>
<td>Impact on ash sales</td>
</tr>
<tr>
<td>• need to landfill</td>
<td></td>
</tr>
</tbody>
</table>

**Are all costs factored into overall life cycle analysis?**
Alternative Approach = Scrubber + Wet ESP
Wet Technologies for HCL, Hg, PM Control

- Wet Scrubbers
- Wet ESPs
Scrubber Limitations for PM Removal

40% Removal on ½ micron particles at 10” w.c.
Why WESP Technology

Multi-Pollutant Control
- $\text{PM}_{2.5}$ (filterable PM)
- $\text{SO}_3$ (condensable PM)
- Metals
- Mercury (limited)
- > 90% control

Opacity Reduction
- <10% visible plume

Operationally
- Low Pressure Drop ( @1.0”) 
- No Moving Parts
- Minimal Maintenance
- Self-Cleaning with water
- Water by-product goes to WFGD
- Smaller footprint than FF
- Flexible to Upset Conditions
- No impact on upstream equipment

Fuel Flexibility
- Switch to lower cost, higher S coal

A Final Polishing Device
# Test Results

## Kyanite- East Ridge Test Results

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Units</th>
<th>Inlet</th>
<th>Outlet</th>
<th>Removal %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO2</td>
<td>Ppm</td>
<td>3580.07</td>
<td>21.4</td>
<td>99.4</td>
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<tr>
<td>ACID MIST (H2SO4)</td>
<td>gr /dscf</td>
<td>0.228</td>
<td>0.0159</td>
<td>93.0</td>
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<tr>
<td>PM2.5</td>
<td>gr /dscf</td>
<td>1.6</td>
<td>0.006</td>
<td>99.6</td>
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<tr>
<td>NOx</td>
<td>Ppm</td>
<td>41.1</td>
<td>21.5</td>
<td>47.7</td>
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<tr>
<td>CONDENSED, INORGANIC</td>
<td>Gr/dscf</td>
<td>0.13102</td>
<td>0.0143</td>
<td>89</td>
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<tr>
<td>CONDENSED, ORGANIC</td>
<td>Gr/dscf</td>
<td>0.14148</td>
<td>0.01573</td>
<td>90</td>
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<tr>
<td>OPACITY</td>
<td></td>
<td>&gt;50%</td>
<td>&lt;5%</td>
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</table>
Pressure Drop Comparison

DSI / PAC / Fabric Filter
= 7”- 12” W.C. pressure drop
May require new ID fans?

Scrubber + Wet ESP
= 7-15” W.C. average pressure drop
Existing ID Fans may be acceptable.

It depends upon situation
Real Estate Comparison

**DSI + PAC+ Fabric Filter**
Velocity = 4-6 fps
@ twice the size of a Scrubber/WESP
Is there room?

**Scrubber + Wet ESP**
Velocity = 7-10 fps
@ Half the size of a FF
Use area between WFGD & stack.
Maintenance Comparison

**DSI+ PAC+ Fabric Filters**
- Bag Replacement every 3-5 years
- Hopper smoldering/fires
- Ash conveying
- A lot of moving parts & ash
- Plugging of injection lines
- Constant maintenance

**Scrubber+ Wet ESP**
- Alloy internals - no replacements
- Everything is saturated & wet
- No moving parts & no ash
- Outage inspection & maintenance

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Environmental Systems & Services
**Process Comparison**

**Scrubber + Wet ESP**
- Better at handling boiler upset conditions
- No DSI or PAC Injection

**DSI/PAC/Fabric Filter**
- More sensitive to boiler upset conditions
- Needs DSI + PAC injection for removal of condensables, mercury
Water Usage Comparison

Fabric Filter
No water used

Scrubber/Wet ESP
Needs source of water
Wastewater treatment
**Capital Cost Comparison**

- **Fabric Filter**
  - $5 - $10/cfm

- **WESP**
  - $10 - $20/cfm

*Equipment Only*
Summary

• Scrubber / Wet ESP offers
  • Removal of both filterable & condensable PM2.5 including
  • HCL, SO2, SO3 (H2S04), metals, and Hg

• Advantages of Scrubber / WESP vs DSI / PAC /FF are:
  • Lower maintenance
  • Less real estate
  • Not as sensitive to upsets

Analyze the economic benefits
  • Lower operating/maintenance costs vs Higher capital cost
Note: 3 Major Regulations Overlap

- **Cement NESHAP Rule**
  - Issued: February 12, 2013
  - **Compliance by:** September 9, 2015
  - Controls: HCL, Hg, PM & THC

- **Industrial Boiler NESHAP Rule**
  - Issued: January 31, 2013
  - **Compliance by:** January 31, 2016
  - Controls: HCL, Hg, PM, CO

- **Utility Mercury Air Toxics (MATS) Rule**
  - Issued: February 16, 2012
  - **Compliance by:** April 16, 2015
  - Controls: HCL (SO2), Hg, PM

*Resources, Pricing and Delivery will be impacted!*
# Boiler MACT Time Line

## Estimated Schedule to meet MACT – September 9, 2015 Compliance Date

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<th>2012</th>
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<th>2014</th>
<th>2015</th>
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<td>1st Q</td>
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Buzz Reynolds
VP – Wet ESP
Siemens Environmental Systems & Services
Siemens Energy
501 Grant Street
4th Floor
Pittsburgh, PA 15219

jamesreynolds@siemens.com
908-522-6616