Boiler MACT Compliance Overview
Pathways to Compliance

The Mandate

Existing boilers must be in compliance with 40 CFR Part 63 Subpart DDDDD (Boiler MACT) by January 31, 2016.

- Control
- Repower
- Retire
Regulated Pollutants

REQUIREMENTS
Regulated Pollutants

- Particulates
- Mercury
- Acid Gases (HCl)
- Organic HAPs (CO)
- Sulfur Dioxide*

* Sulfur dioxide control is not part of Boiler MACT
Air quality control

CONTROL
## Emission Limits

<table>
<thead>
<tr>
<th>Subcategory</th>
<th>Pollutant</th>
<th>Heat Input Basis</th>
<th>Alt. Steam Output Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Limit</td>
<td>Units</td>
</tr>
<tr>
<td><strong>Coal/Solid Fuel</strong></td>
<td>Hg</td>
<td>5.7E-06</td>
<td>lb/MMBtu</td>
</tr>
<tr>
<td></td>
<td>HCl</td>
<td>2.2E-02</td>
<td>lb/MMBtu</td>
</tr>
<tr>
<td></td>
<td>Filterable PM (or TSM)</td>
<td>4.0E-02 (or 5.3E-05)</td>
<td>lb/MMBtu</td>
</tr>
<tr>
<td><strong>Pulverized Coal</strong></td>
<td>CO (or CEMS)</td>
<td>130 (or 320) ppmvd @ 3% O₂</td>
<td>0.11</td>
</tr>
<tr>
<td><strong>Stoker Coal</strong></td>
<td>CO (or CEMS)</td>
<td>160 (or 340) ppmvd @ 3% O₂</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>FB Coal</strong></td>
<td>CO (or CEMS)</td>
<td>130 (or 230) ppmvd @ 3% O₂</td>
<td>0.12</td>
</tr>
<tr>
<td><strong>FBHE Coal</strong></td>
<td>CO (or CEMS)</td>
<td>140 (or 150) ppmvd @ 3% O₂</td>
<td>1.3E-01</td>
</tr>
</tbody>
</table>

**Notes:**
1) Emission limits must be met at all times excluding startups and shutdowns.
2) CO limits are based on a 3-run average of 1 hour samples.
3) CEMS limits for CO are based on a 30 day rolling average.
Filtered PM (or TSM) Control

• Most common methods include fabric filters (bag houses), wet or dry ESPs, and wet scrubbers.
• Fabric Filters are the best choice for filterable PM.
• Wet Scrubbers or wet ESPs are preferred for condensable PM.
Fabric Filters

• Very high control efficiencies: 98-99%
• Limited operating temperature ranges, typically less than 400 °F.
• Utilize high efficiency PTFE membranes for maximum performance.
• Sized to accommodate loading from upstream equipment (PAC and DSI systems).
Typical Fabric Filter
Mercury Control

- Most common method is Powder Activated Carbon (PAC) aka Activated Carbon Injection (ACI).
- Effective for Hg, Dioxins/Furans, and VOC.
- Installed upstream of a baghouse or dry ESP.
- Silo or bulk bag system.
- Typically 90-95% Hg removal.
Typical PAC System
Acid Gases (HCl) Control

- Most common method is Dry Sorbent Injection with one of the following:
  - Hydrated Lime (calcium hydroxide): Ca(OH)$_2$
  - Baking Soda (sodium bicarbonate): NaHCO$_3$
  - Trona (sodium sesquicarbonate): $\text{Na}_2\text{CO}_3\cdot\text{NaHCO}_3\cdot2\text{H}_2\text{O}$

- Also provides SO$_2$ and (minimal) NO$_x$ control.
- Installed upstream of a baghouse or dry ESP.
- Silo or bulk bag system.
- Typically 80-90% HCl removal.
Typical DSI System
NO$_x$ Production Rate versus Equivalent Ratio

NO. 2 OIL, 10 ATM
AIR PREHEAT 590 K (600 ºF)

HIGH CO EMISSIONS
HIGH SMOKE EMISSIONS

EQUIVALENCE RATIO
LEAN ← 0.5 1.0 1.5 ← RICH

NO$_x$ (PPMV / MS)

Temperature

d NO
dt
(RATE OF PRODUCTION OF THERMAL NO$_x$)
Carbon Monoxide Control

• Most boilers will be able to meet the CO limits with proper Operation and Maintenance.
  – Good combustion practices.
    • Proper temp, air/fuel ratios, and residence time.
  – Burner maintenance.
  – Oxygen control packages.

• Post combustion control technologies include:
  – Catalytic oxidation systems.
  – Thermal oxidation.
Work Practice Standards

- Units shall conduct a boiler tune-up annually as specified in 63.7540 as a work practice for dioxins/furans.
- Must have a one-time energy assessment performed by a qualified energy assessor per the requirements in 63.7575.
- Adhere to startup and shutdown requirements in Table 3 to Subpart DDDDD.
Unit Repowering

REPOWER
Repowering Options

- Consider fuel switching (e.g., biomass)
- Consider boiler/burner conversions to NG.
- Consider cogeneration utilizing Heat Recovery Steam Generators (HRSGs).
Unit Retiring versus New Replacement.

RETIRE
Retirement of Assets

- Replace steam needs through alternate means:
  - NG package boilers
  - HRSGs
  - Purchase from co-located utility

- If feasible, eliminate steam entirely and convert plant HVAC to direct-fired NG.