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# 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

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Regulated Pollutants

# REQUIREMENTS

# Regulated Pollutants

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

* Sulfur dioxide control is not part of Boiler MACT

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Air quality control

# CONTROL

# Emission Limits

| | | Heat Input Basis | | Alt. Steam Output Basis | | | | |
|---|---|---|---|---|---|---|---|---|
| **Subcategory** | **Pollutant** | **Limit** | **Units** | **Limit** | **Units** | | **Limit** | **Units** |
| Coal/Solid Fuel | Hg | 5.7E-06 | lb/MMBtu | 6.4E-06 | lb/MMBtu | | | |
| Coal/Solid Fuel | HCl | 2.2E-02 | lb/MMBtu | 2.5E-02 | lb/MMBtu | | | |
| Coal/Solid Fuel | Filterable PM (or TSM) | 4.0E-02 (or 5.3E-05) | lb/MMBtu | 4.2E-02 (or 5.6E-05) | lb/MMBtu | **OR** | 4.9E-01 ( or 6.5E-04) | lb/MWh |
| Pulverized Coal | CO (or CEMS) | 130 (or 320) | ppmvd @ 3% $O_2$ | 0.11 | lb/MMBtu | **OR** | 1.4 | lb/MWh |
| Stoker Coal | CO (or CEMS) | 160 (or 340) | ppmvd @ 3% $O_2$ | 0.14 | lb/MMBtu | **OR** | 1.7 | lb/MWh |
| FB Coal | CO (or CEMS) | 130 (or 230) | ppmvd @ 3% $O_2$ | 0.12 | lb/MMBtu | **OR** | 1.4 | lb/MWh |
| FBHE Coal | CO (or CEMS) | 140 (or 150) | ppmvd @ 3% $O_2$ | 1.3E-01 | lb/MMBtu | **OR** | 1.5 | lb/MWh |

*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.*

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# 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


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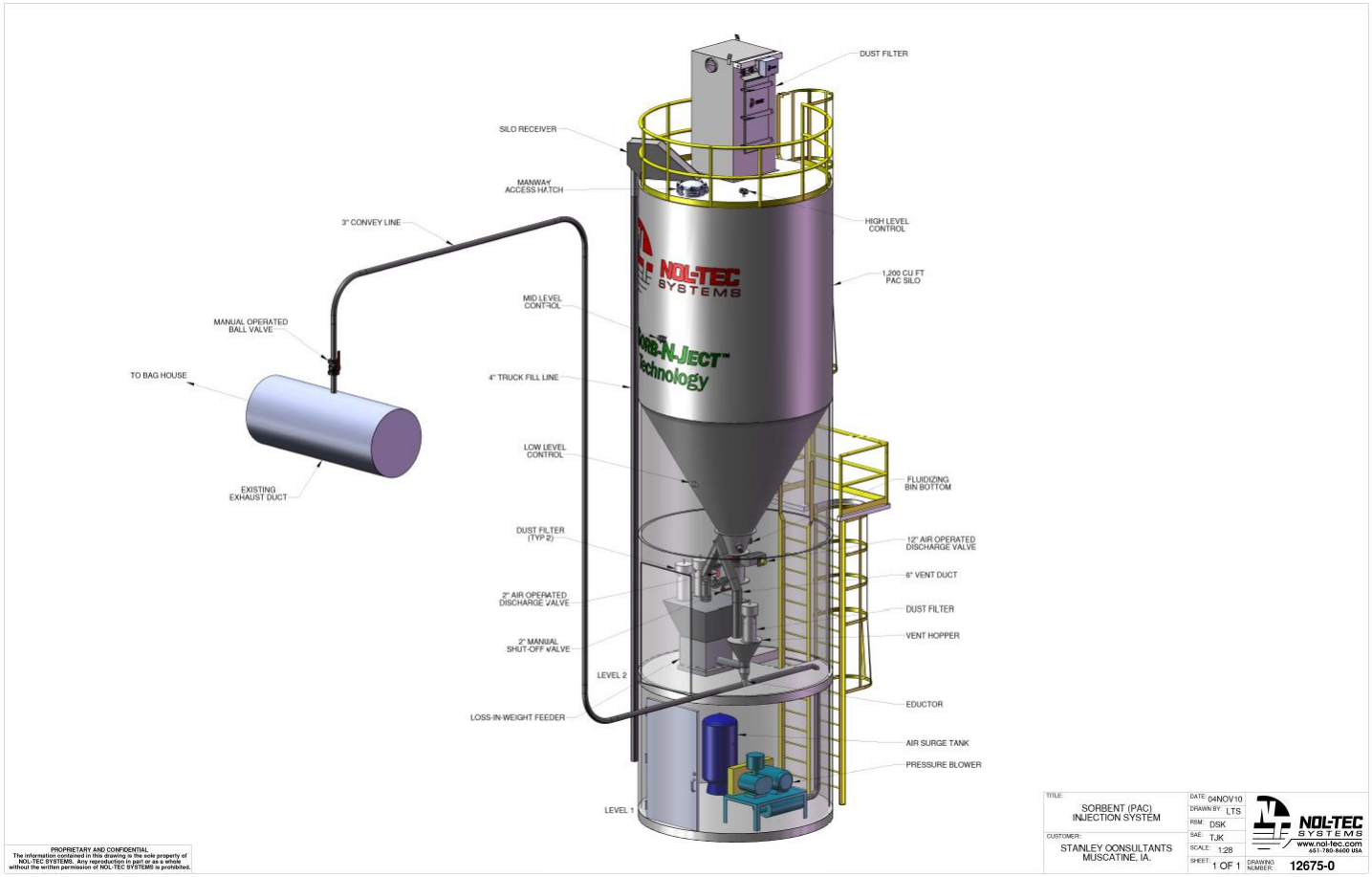
# Mercury Control

- 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

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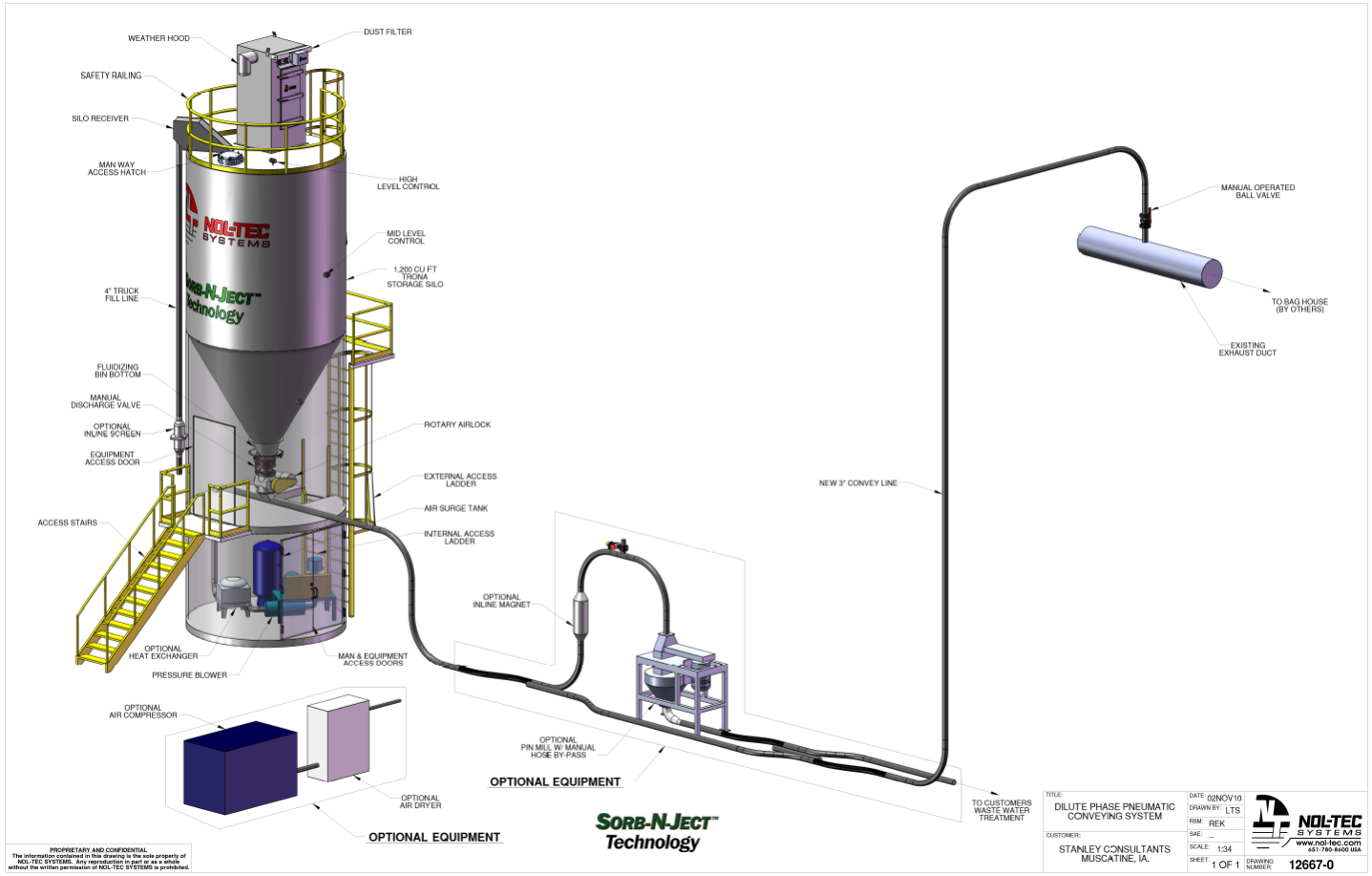
# Acid Gases (HCl) Control

- 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): $Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$
- 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

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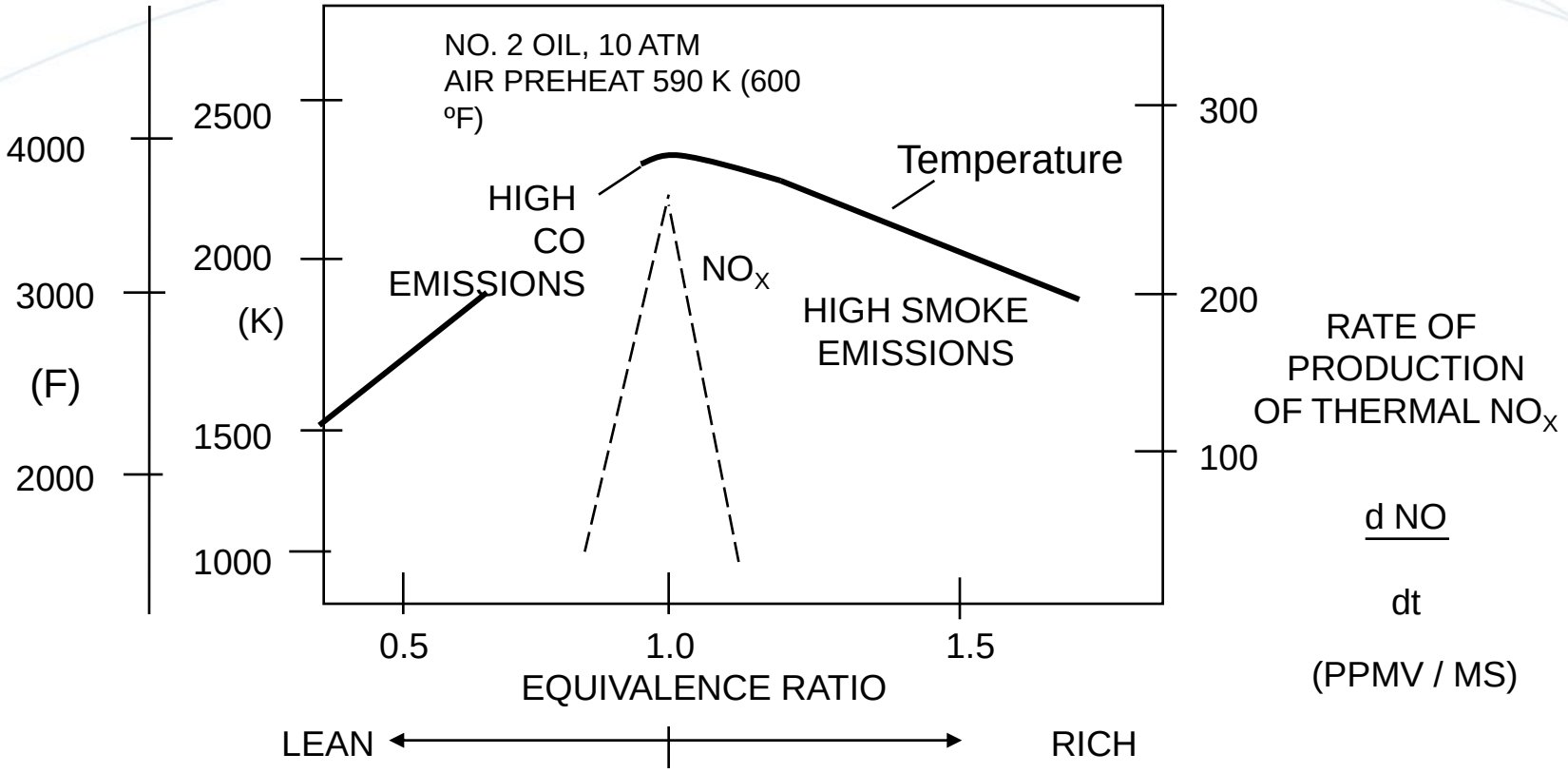
# $NO_X$ Production Rate versus Equivalent Ratio

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# 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.

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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).

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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.

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