O&M Issues DSI Systems
Startup, Shutdown & Cycling Loads

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McIlvaine Hot Topic  July 10.2014
EPA Requested Comments on Proposed New Rules Startup-Shutdown-Maintenance (SSM)

• Request published on 6/25/13 based on rules proposed 12/30/12
• Reopened comment period limited to 3 questions
• Institute of Clean Air Companies (ICAC) submitted comments on 8/26/13 addressing
  • SCRs & SNCR
  • ESPs
  • Baghouses
  • Wet and Dry FGD
  • DSI & carbon injection

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O&M Issues Coal Fired Plants

• Startup – Shutdown Rules
• Start averaging time using a default electrical production
  • 25% of nameplate capacity plus 3 hrs. or
  • the start of electricity generation plus 6 hrs., whichever comes first;
• Other Industry Challenges Cycling Loads
• “Green” Energy and gas price: coal plant cycling
  • Shutdowns: hours to a few days
• Low load operations
• Improved heat rate for CO₂ Rule
DSI Challenges

- How soon can we turn or turn off on DSI & carbon systems.
- Prevent deposits forming in ductwork.
- Sorbent contact with acid gases/Hg at low flow conditions - mass transfer
- Does the chemistry work at lower temperatures seen during startup/shutdown?
- Contact time
- Impacts on balance of plant
What Can We Do?

• Modeling - most modeling for flow distribution and deposition done at full load conditions.
• Need to model at low flow conditions
• Inspections of ductwork after cycling operations
• Use CEMS when possible to optimize sorbent injection.
• Other
  • Better distribution
  • More frequent tuning
  • Frequent cleaning of catalyst & airheater
  • DSI injection ahead of airheater
Benefits of DSI Injection During Start/Shutdown and Cycling Operations

- With increased cycling operations we expect to see increased corrosion along the flue gas path. Lime injection could mitigate corrosion that will develop with these operating conditions.
- Allow SCRs to startup earlier (lower operating temp.)
  - Startup - Shutdown Conditions
    - Turn on ammonia \( \approx 600 \, ^\circ F \)
      - Actual depends on fuel primarily sulfur
    - SCRs are temperature driven – no relationship to MW generation

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**Typical SCR Startup & Shutdown**

- **Startup - Shutdown Conditions**
  - Temperature limited by ABS formation that fouls airheater
  - ABS needs $\text{SO}_3$ and $\text{NH}_3$
  - Take $\text{SO}_3$ out and you can start injecting $\text{NH}_3$ sooner which will result in reducing NOx and being in compliance sooner limit to less than 5 ppm
  - Inject before catalyst or airheater
    - May be able to lower startup temperature from 600 °F to 540 °F
Benefits of Pre-APH Removal of SO$_3$

**Improve Heat Rate/Reduce CO$_2$ Emissions**

- Reduce SO$_3$ Dew Point prior to APH
- Reduce operating temperature of APH

40°F reduction $\rightarrow$ 1% heat rate improvement $\rightarrow$ 1% savings on fuel budget

- Reduction in CO$_2$ emissions
  - 1 lb coal $\rightarrow$ 2.5 lb CO$_2$
DSI Challenges

- Emissions Control
- Operate over wide range of load conditions
- Can it play a role in heat rate improvement
- “Net” low cost sorbents that do not impact other APC equipment performance and ash management
DSI Design

• Periods of operation, especially for boiler startup, characterized by rapid transient changes in flue gas composition, quantity, temperature, and moisture conditions.

• The problems are aggravated with installation of multiple APC equipment and processes, especially those required to achieve MATs compliance.

• Minimize Sorbent usage
  • Cost
  • Ash
  • Other APC equipment
Key To DSI Design

• Distribution of sorbent
• Get the sorbent to the pollutant in the flue gas
• Adjustable feed rate – don’t overfeed or underfeed
• Modeling
• Mixing
• Maintain Ca/air ratio in transport pipe and injectors
  • Plugging at low flow
  • Mat need to overfeed
DSI System – for SO₃ Control

• Target feed rates established during stack test period
  • Complete load profile, not all at full load
  • Coal sulfur content ranges

• In line monitoring of emissions
  • SO₃ : Breen, SICK, Stack visual
  • SO₂ : CEMS
  • Hg : CEMS (indirect method)
Injection Pre-SCR

**Benefits**
- Earlier control of $\text{SO}_3$
- Longer contact time
- Enhanced mixing

**Concerns**
- Fouling of catalyst
- No signs of deactivation on test conducted to date
Questions & Answers

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