“Optimization of Air Pollution Control Systems”

Mcilvaine Webinar
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Today’s Fossil Generation Challenges

- Unprecedented regulatory uncertainty
  - CSAPR
  - Utility MACT
  - Federal CO₂ regulation
  - Subsequent Clean Air Act Requirements (NAAQS, Regional Haze, etc.)

- Traditional and new sources of market volatility
  - Demand uncertainty (fighting the last war)
  - Fuel and allowance price volatility
  - Technological uncertainties

- All add to challenges bringing new capacity on-line
- CCCTs & renewables force new operating profiles
- Aging assets operating well beyond design life
- Graying work-force and skills shortage

Do more with less and manage the risks!
Environmental Regulatory Timeline for Coal Units

**Ozone**
- Revised Ozone NAAQS
- Beginning CAIR Phase I Seasonal NOx Cap
- Beginning CAIR Phase I Annual SO2 Cap
- Proposed CAIR Replacement Rule Expected
- Final Rule for CCBs Mgmt
- Final EPA Nonattainment Designations

**SO2/NO2**
- SO2 Primary NAAQS
- NO2 Primary NAAQS
- CO2 Regulation
- HAPs MACT proposed rule
- HAPs MACT final rule expected
- New PM-2.5 NAAQS Designations
- Begin Compliance Requirements under Final CCB Rule (ground water monitoring, double monitors, closure, dry ash conversion)

**CSAPR**
- Effluent Guidelines Final rule expected
- Next Ozone NAAQS Revision
- SO2/NO2 Secondary NAAQS
- 316(b) final rule expected
- 316(b) Compliance 3-4 yrs after final rule
- Beginning CSAPR Phase II Annual SO2 & NOx Caps
- Compliance with CSAPR Replacement Rule
- HAPS MACT Compliance 3 yrs after final rule

**Water**
- Effluent Guidelines Compliance 3-5 yrs after final rule
- Beginning CSAPR Phase II Seasonal NOx Cap

**PM2.5**
- PM-2.5 SIPs due ('07)
- Begin CAIR Phase I Annual SO2 Cap
- Proposed Rule for CCBs Management
- 316(b) proposed rule expected
- New PM-2.5 NAAQS Designations

**Ash**
- Proposed CAIR Replacement Rule
- Final PM-2.5 NAAQS Revision
- PM-2.5 SIPs due ('06)

**Hg/HAPS**
- CAMR & Delisting Rule vacated
- CAIR Vacated
- CAIR Remanded
- HAPS MACT final rule expected
- Compliance with CSAPR Replacement Rule
- HAPS MACT Compliance 3 yrs after final rule

**CO2**
- 316(b) Compliance 3-4 yrs after final rule
- New PM-2.5 NAAQS Designations
- Begin Compliance Requirements under Final CCB Rule (ground water monitoring, double monitors, closure, dry ash conversion)

-- adapted from Wegman (EPA 2003)
CSAPR for NOx Reduction

- Affected power plant NOx emissions required to be reduced by 54% by 2014
- 26 states would be required to reduce NOX emissions during the ozone season to help downwind states attain NAAQS standards
  - Specifically the 1997 ground-level ozone standard
- Supplemental NOPR adds Ozone Season limits for NOx to five states covered by PM 2.5 plus Louisiana
- Most allowances for 2012 have already been allocated and deposited
- Emissions reductions required very quickly, in 2012 – less than two months from now!

Proprietary and Confidential
Near-Term CSAPR Rule Compliance Alternatives

- De-rate units
  - Live with reduced revenue and increased cost for less efficient gas-fired generation
- Change fuels – haven’t already looked at this?
- Stage deeper with LNBs and OFA
  - Live with more erosion & tube leaks & slagging
- Run SCRs and/or SNCRs harder
  - Live with reagents costs & slip & plume & pluggage
- Optimize your boilers
  - Reduced and less variable boiler NOx
  - Deeper staging with less slagging and corrosion
  - Greater removal from SCRs/SNCRs w/fewer side-effects
Longer-Term Strategic Implications

- Minimize capital commitments for CSAPR while emerging regulatory changes make clear which units can survive and which cannot.
- Inform future capital decisions for surviving units with better understanding of true (optimal) baseline performance.
- Better equip surviving units to cope with:
  - Greater demands on existing emissions control hardware
  - Process changes and variable costs for new emissions hardware
  - Operational profiles associated with fundamentally altered markets
    - Influx of renewables with intermittent generation output profiles
    - Reduced capacity factor due to more efficient newer capacity coming on-line
    - Problems associated with aging assets and changes from design conditions
    - Greater operational challenges with fewer skilled operators and engineers
    - Ever-greater needs to “push the envelope” in order to “stay in the money”
NeuCo’s total Boiler Optimization software solution:
- Optimizes boiler performance in closed loop to improve unit reliability, efficiency & emissions

Combines CombustionOpt® and SootOpt® products

Uses a combination of optimization technologies:
- Neural networks, expert rules, model predictive control

Continually manages interrelated boiler variables:
- Combustion quality, fuel & air mixing, gas & steam temps, fouling, tube erosion & emissions

Manages tradeoffs between combustion and heat transfer processes
- Aligns them with overall performance and emissions objectives

Adjusts to fluctuating constraints & changing objectives
Optimization can provide benefits in all these areas:

- Heat Rate – NOx – MW – Commercial Availability
- CO$_2$ – Opacity – SO$_2$ – Equipment Reliability
- LOI – Particulates – Hg – Steam Temps
- CO – Ramp Rates – NH$_3$ usage – Attemperation Sprays
- Aux Power – Operational Consistency – Slagging & Fouling

Maximum benefits can only be achieved with an integrated platform approach

Platform designed for fleet-wide application, where benefits can be realized in manner best suited to differing organizations

- Plant use
- Centralized “war room”
- Tailored service offering
- Any combination of these
Indirect Optimization Benefits

- Process Illumination
- Tradeoff Management
- Expertise Codification
- KPI-Focused Workflow
- Analysis & Decision Support
- Set-Point Refinement
- Dynamic Uncertainty Management
Emissions and efficiency used to be addressed by different “silos” within power generation organizations.

Efficiency efforts often took back-seat to emissions:

- Regulatory “pass-through” clauses

Fuel costs often handled fleet-wide.

$\text{CO}_2$ has brought efficiency and emissions together.

Reagent costs for NOx create large new “non-fuel” O&M cost.

**Bottom Line:** Must integrate management of emissions, fuel, reagent costs and tradeoffs between them.
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