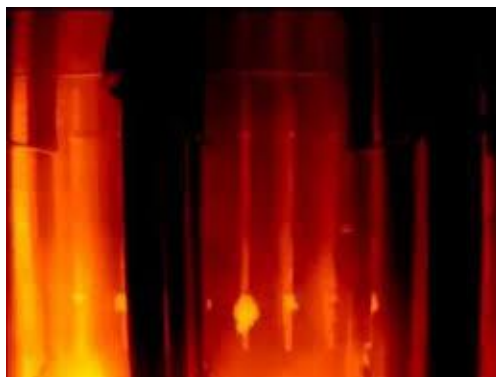




Innovative Chemistry for Energy Efficiency





About EES

EES is a privately held clean coal technology company that provides innovative chemistry for energy efficiency. Formed in 1992, EES serves customers through a specially trained network of sales professionals and field service technicians in North America and three international locations. EES is headquartered in Sandy Hook, Connecticut, USA.

Connecticut Office

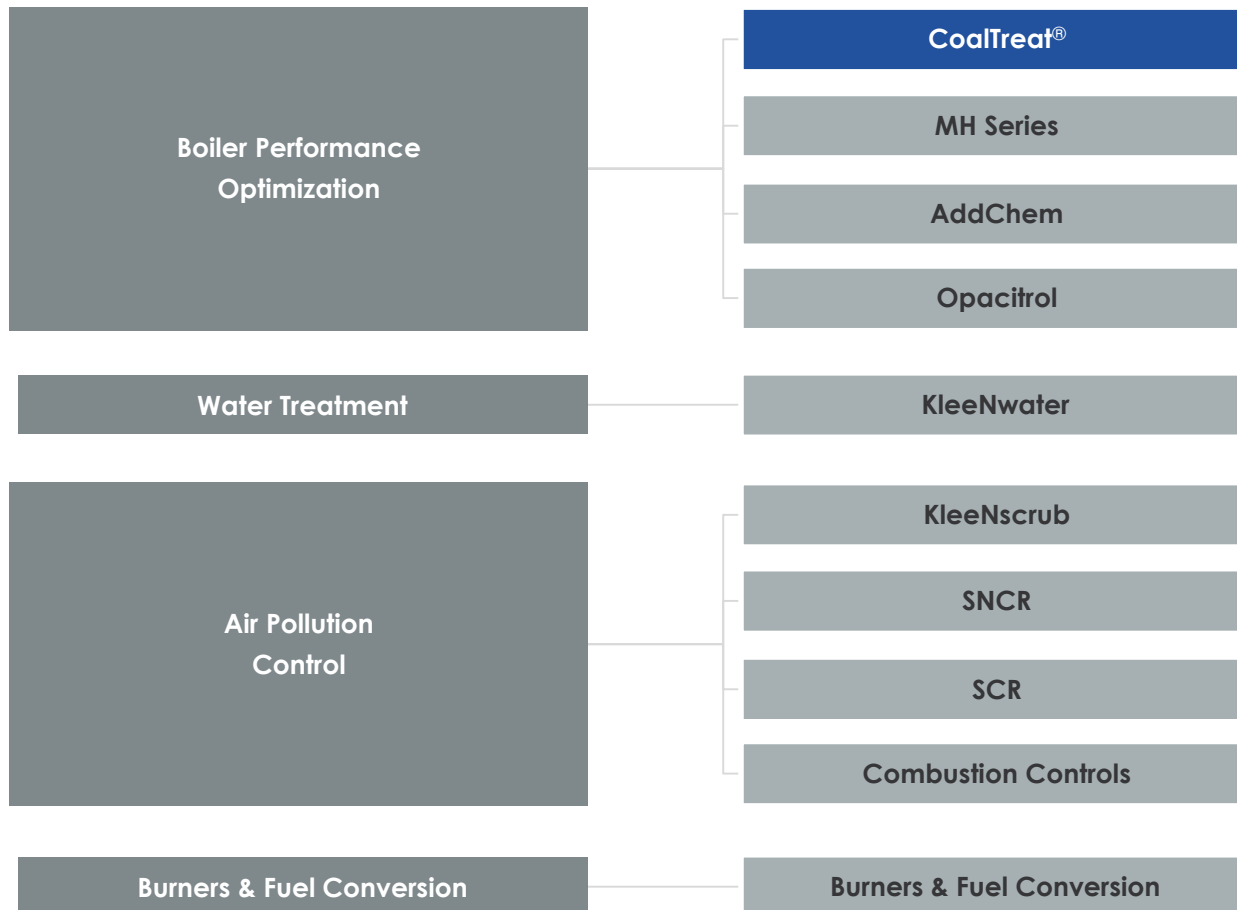
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Visit us online
www.eescorp.com

About STEP Combustion

- **STEP was established in 2005:**
 - Provide burners, engineering services, and APC equipment to utility and large industrial customers
- **Background:**
 - Expertise in aero, fluid and thermodynamics
 - 20+ years of numerical modeling experience (Fluent CFD, FEA, etc.)
- **Technologies:**
 - Combustion Technologies: Burner Upgrades, LNB
 - In furnace NO_x Reduction
 - Post combustion NO_x reduction technologies (SNCR, SCR)
- **STEP Purchased by EES, Inc. in January 2017 to compliment EES' technology platforms. EES established in 1992:**
 - Additives (Anti-slag, Low Opacity, Efficiency Improvement)
 - KLeeNwater (water treatment systems)
 - Hg Capture (Re-emission Control)

Products & Solutions



CoalTreat[®]

- **CoalTreat[®]**, a fuel chemistry innovation developed by Environmental Energy Services (EES), proven highly effective in mitigating problems attributed to furnace slagging, and heat transfer surface fouling.
- **CoalTreat[®]** is applied to the fuel precombustion, customized to each plant's fuels and specific objectives, and has been successfully deployed on several large fleet coal-fired units in the United States for many years



Benefits of CoalTreat®

- Greater fuel flexibility to burn opportunity fuels for economic & regulatory benefit
- Increased heat rate (efficiency) with improved heat transfer and reduced boiler exit gas temperature
- Improved soot-blower performance and reduced forced outages (slag and tube wastage related outages)
- Improved MW output through reducing or eliminating high load de-rating

Simulations, Slagging & Testing

Simulate Coal Blending with Advanced Chemistry

- Think outside the box
- Coal yard blending operations limit fuel choices
- CoalTreat® offers the same effect through the application of customized reagents
- Correcting coal ash chemistry in real-time

Slagging Summary

- Coal composition – starting ash chemistry will determine what type of slag to expect
- Grind has to be good to minimize slagging
- Temperature and O₂ levels in the furnace determine whether crystallization is possible or fluxing will be required
- Alumina/Silicate glass, calcium, iron, sulfur and alkalis work together to form slag

Testing for Assessing Performance

- Fusion Temperatures, Mineral Analysis
- High Temperature Probe
 - EES patented method
- Slag Viscosity
 - Calculations or Physical Measurement
- SEM, X-Ray Diffraction
 - Crystal composition

Permanent CoalTreat[®] System



Taking the Science to a New Level

- **SMART System** has been installed
 - CoalTreat[®] formulations and dosages are controlled by signals from an On-line coal analyzer
 - This ensures the correct dosage and blend in real time
- Conducting testing with advanced clays for high temperature slagging

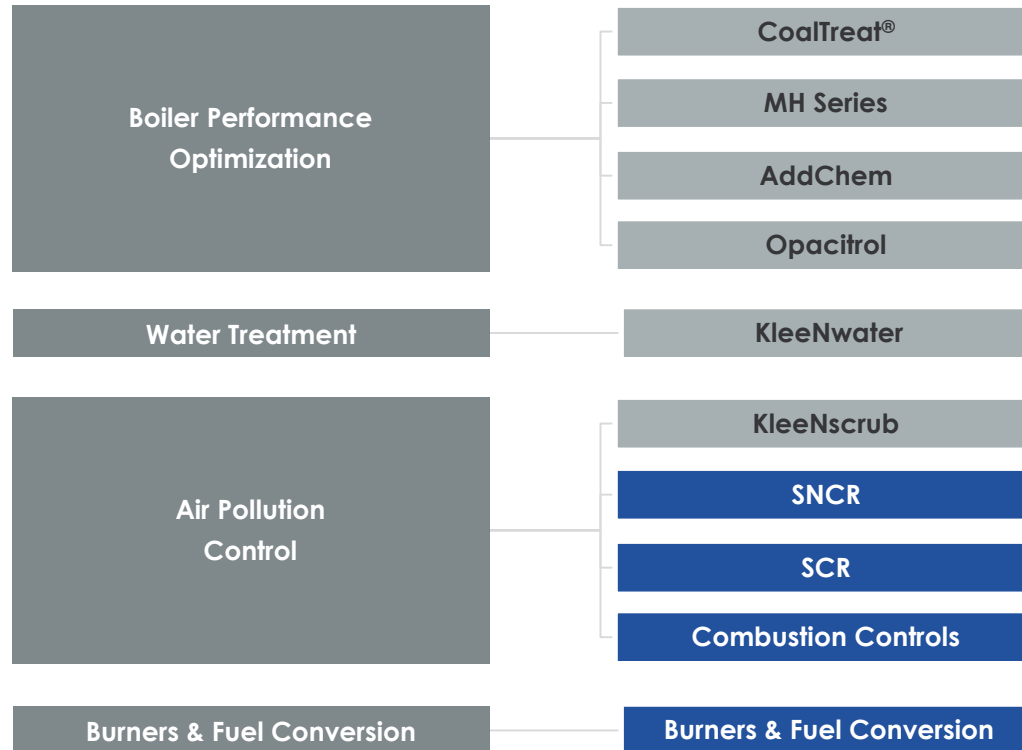
Take Away Points

- **Coal ash chemistry can be corrected** with highly reactive versions of the constituents already present in the ash
- A thorough **analysis of the ash** is required before and after designing the chemical solution
- You cannot make the corrections with particles that are the same size as the ash coming from the pulverizers
 - They will not react fast enough
- CoalTreat® is applied on an **“as needed basis”** for the best economics
- CoalTreat® “On Demand” systems are set up within 2 weeks provided the site has been prepared by the customer
- EES has systems in stock for immediate deployment

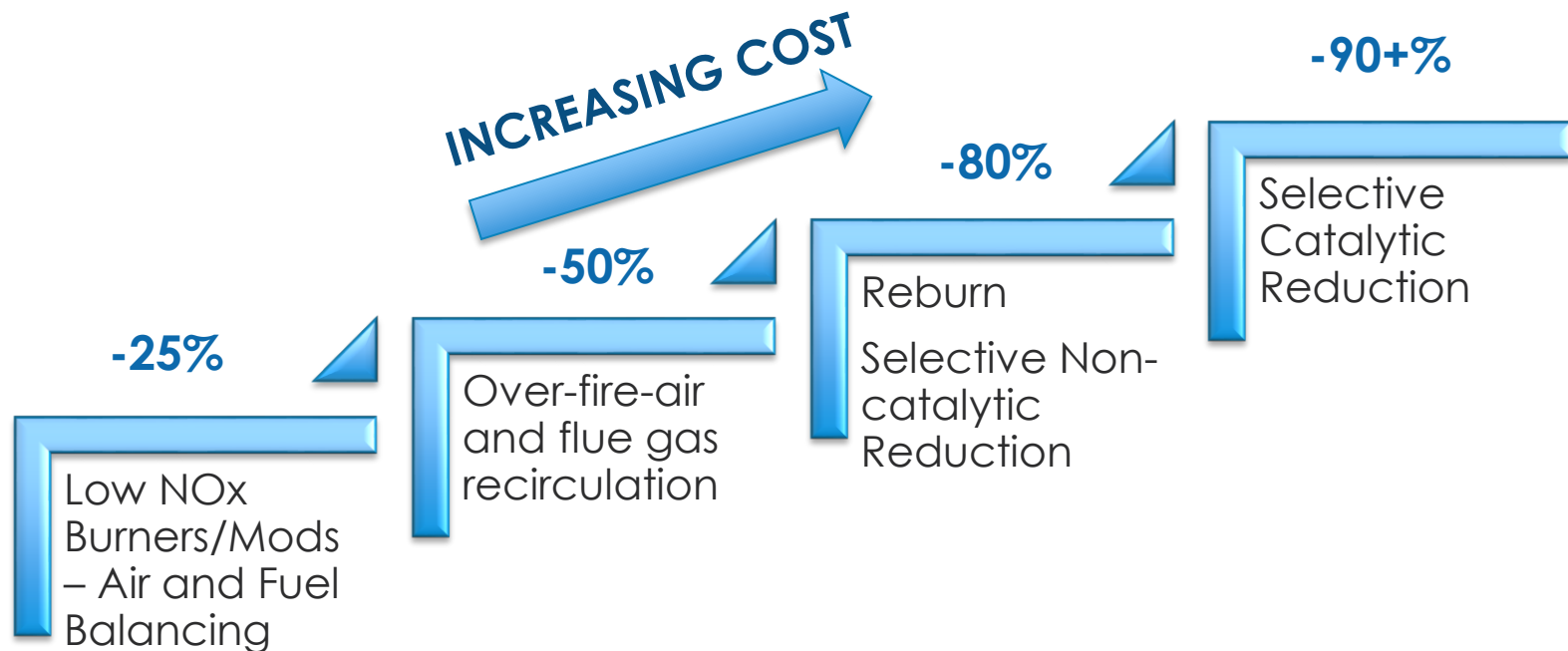
CoalTreat[®] Topics Addressed....

- Fuel chemistry and how **CoalTreat[®]** programs reduce slagging and fouling in coal-fired boilers
- Improvements in heat transfer efficiency associated with reduced fouling of boiler surfaces
- Indian Coal & Ash – Comparison to existing database & field experience
- Indonesian Coal & Ash – Comparison to existing database & field experience
- **CoalTreat[®]** impact on ABS formation and removal of SO₃ and acid gas
- High Temperature Probe (HTP) testing, visual boiler inspections and plant DCS data to evaluate and optimize the performance of **CoalTreat[®]**
- Expected ROI using **CoalTreat[®]** for coal fired power plants

Air Quality Control Systems

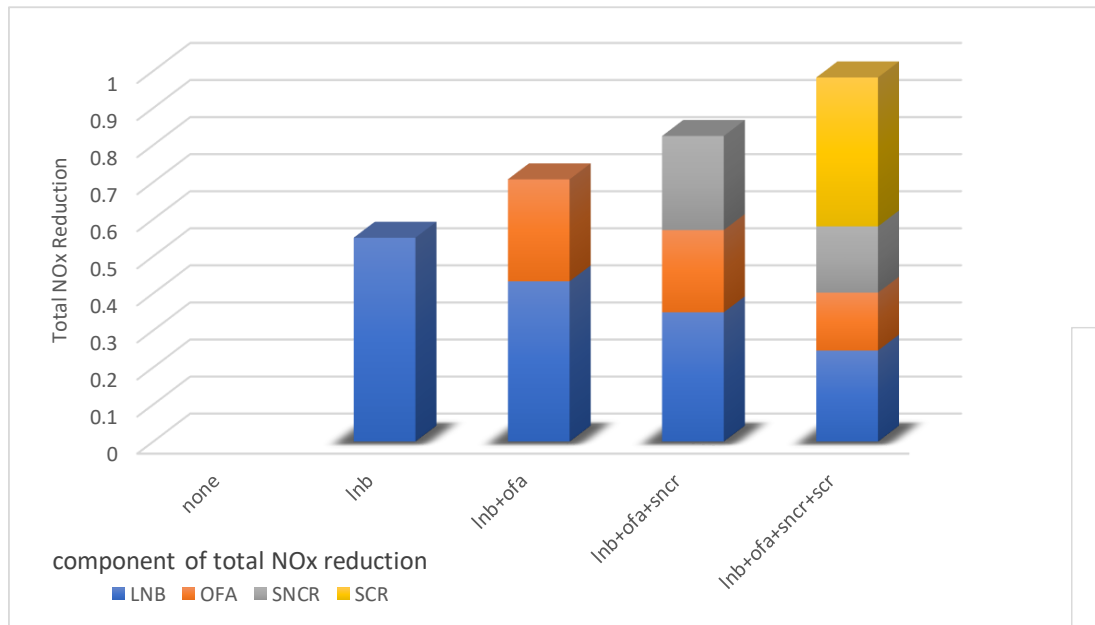


The STEP-wise approach provides an economical strategy and complimentary NOx reduction

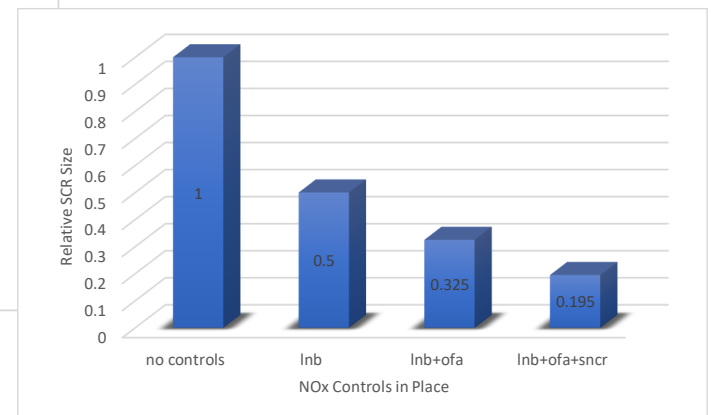


Benefits of the STEP-wise approach to NOx Reduction

Cumulative NOx Reduction



Impact to SCR Size (and cost)



NOx Reduction Strategies - Summary

– Technology Selection Strategy

- High Reduction vs. Low Cost
- Capital Costs vs. Operating Costs
- Additional Equipment vs. Equipment Enhancement
- Space Constraints

– Compliance Strategy

- Meeting Current Targets vs. Future Targets

– Operational Strategy

- Baseload unit vs. Intermittent unit
- Operating Conditions (O₂, CO, Temperatures)
- NOx-reducing Equipment vs. Cleaner Coal

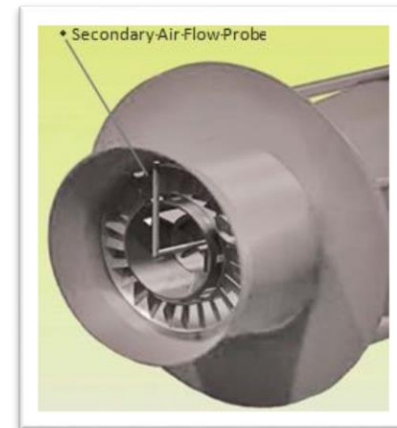
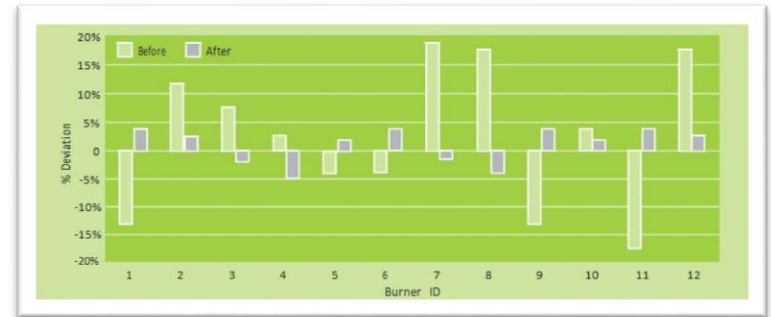
DeNOx Topics Discussed

– Tuning

- Airflow Balancing
- Fuel Balancing/Coal Mill Tuning
- Fuel Balancing/Coal Mill Tuning (2)
- Combustion Tuning and Diagnostic
- Case Studies

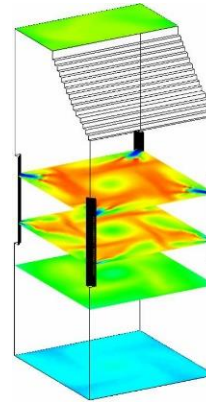
– Burner Upgrades

- Burner Design Parameters
- STEP Low NOx Fuel Injectors
- Over-Fire-Air
- Flue Gas Recirculation (FGR)



DeNOx Topics Discussed

- **Over-Fire-Air**
 - Performance & NOx Reduction
- **Flue Gas Recirculation (FGR)**
 - Performance & NOx Reduction
- **SNCR**
 - Performance & NOx Reduction
 - Typical SNCR Configuration
 - SNCR System Operating Temperature Range
 - Ammonia Slip
- **STEP Wise Low Cost Approach to NOx Reduction**





Contact Us

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