

REINHOLD ENVIRONMENTAL Ltd.



**2018 NO_x-Combustion Round Table
& Expo Presentation**

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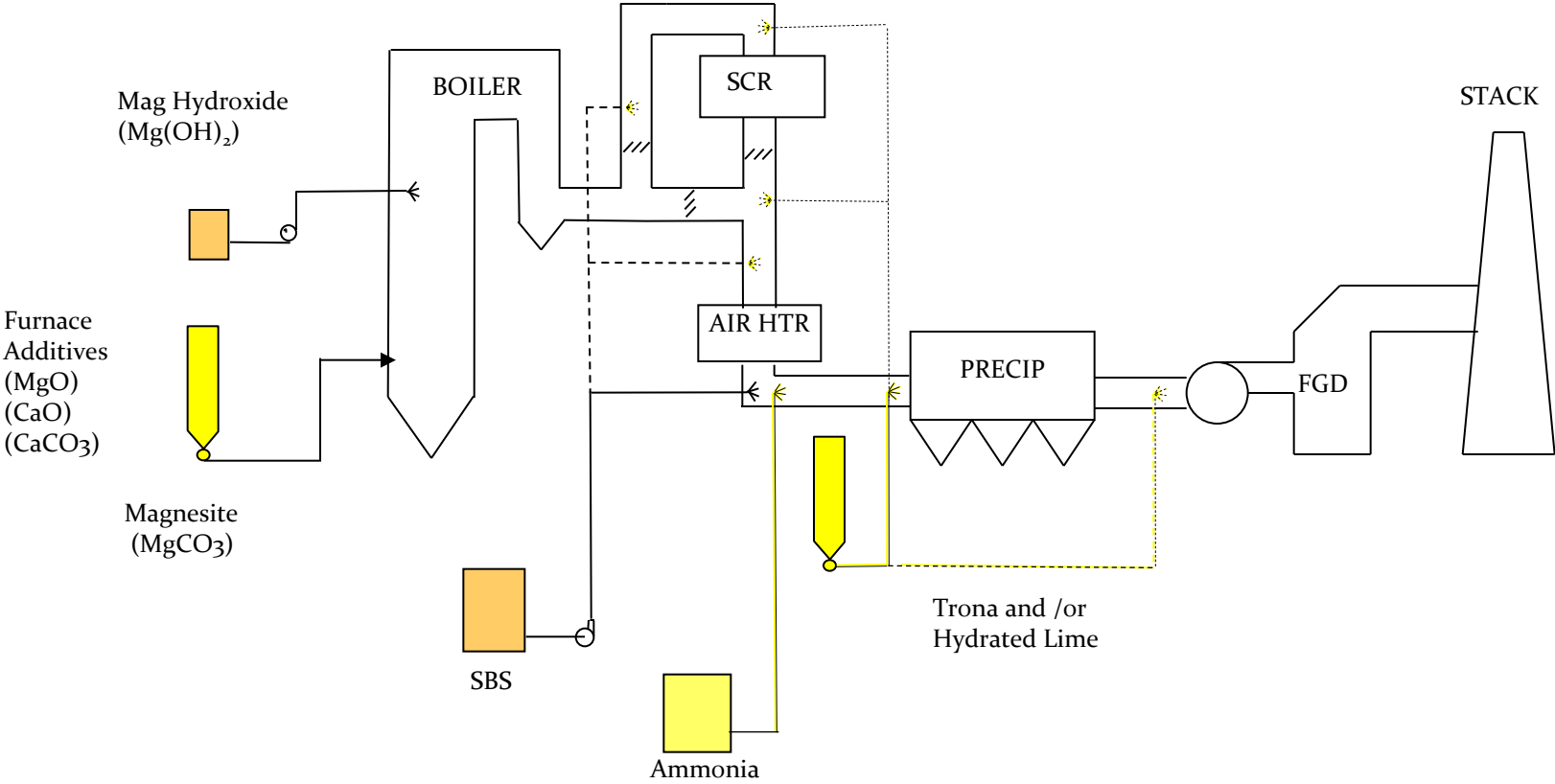
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Hydrated Lime Injection Upstream of the SCR to Mitigate SO₃

2018 NO_x RT
Mark Thomas & Associates
Consulting, LLC

SO₃ MITIGATION STRATEGIES



Pre-SCR Hydrated Lime DSI to Mitigate SO₃

- **WHY CONSIDER?**
 - Low Load/ Extended SCR & Unit Turndown
 - Need Pre-APH or Pre-ESP/FFDC DSI but have Physical Constraints for DSI installation
 - Possibly More Simple Installation
 - Possible Performance Improvements

- **FACTORS TO CONSIDER?**
 - What is Objective?
 - SCR Turndown/ MOT Reduction?
 - APH Pluggage Protection?
 - Improved Performance & Residence Time?
 - Other?
 - What is expected operational profile
 - Inject Only at Min Load or Continuously?
 - AH Protection?
 - Expected SCR NOx Removal Requirements?
 - What Potential Negative Impacts
 - Catalyst Blinding?
 - Pluggage/ Layout Potential
 - Other?

CATALYST IMPACTS DISCUSSION

Primary Concern for Catalyst Impacts is

- Submicron CaO
- High concentrations of CaO
- Primarily a concern for PRB coals
 - Fly Ash can contain 20-25% CaO

Pre-SCR DSI has not shown any negative Catalyst Impacts

- Hydrated Lime is $\text{Ca}(\text{OH})_2$ not CaO
- Particle size is significantly larger
- Concentration of $\text{Ca}(\text{OH})_2$ in ash is ~2%-8% which is in significantly lower than for PRB Coals

Catalyst Pluggage Concerns

- Physical Pluggage Mechanism
- Depends on existing ash pluggage situation
 - Ash Falls from excessive buildups especially at low load.
 - Buildups on Turning Vanes, etc
- Will require careful control of lime feed at low load

DESIGN CONSIDERATIONS

- SCR Design – Space Limitations
- Lime Dispersion Important
- Mixing Critical if Load Following / MOT is primary
 - Existing Static Mixing Devices for NH₃?
 - Distance to AIG & Catalyst
- % RMS not as strict as for SCR but depends on situation
- Can Use Existing Static Mixers if possible
- Lance Design and Location very important

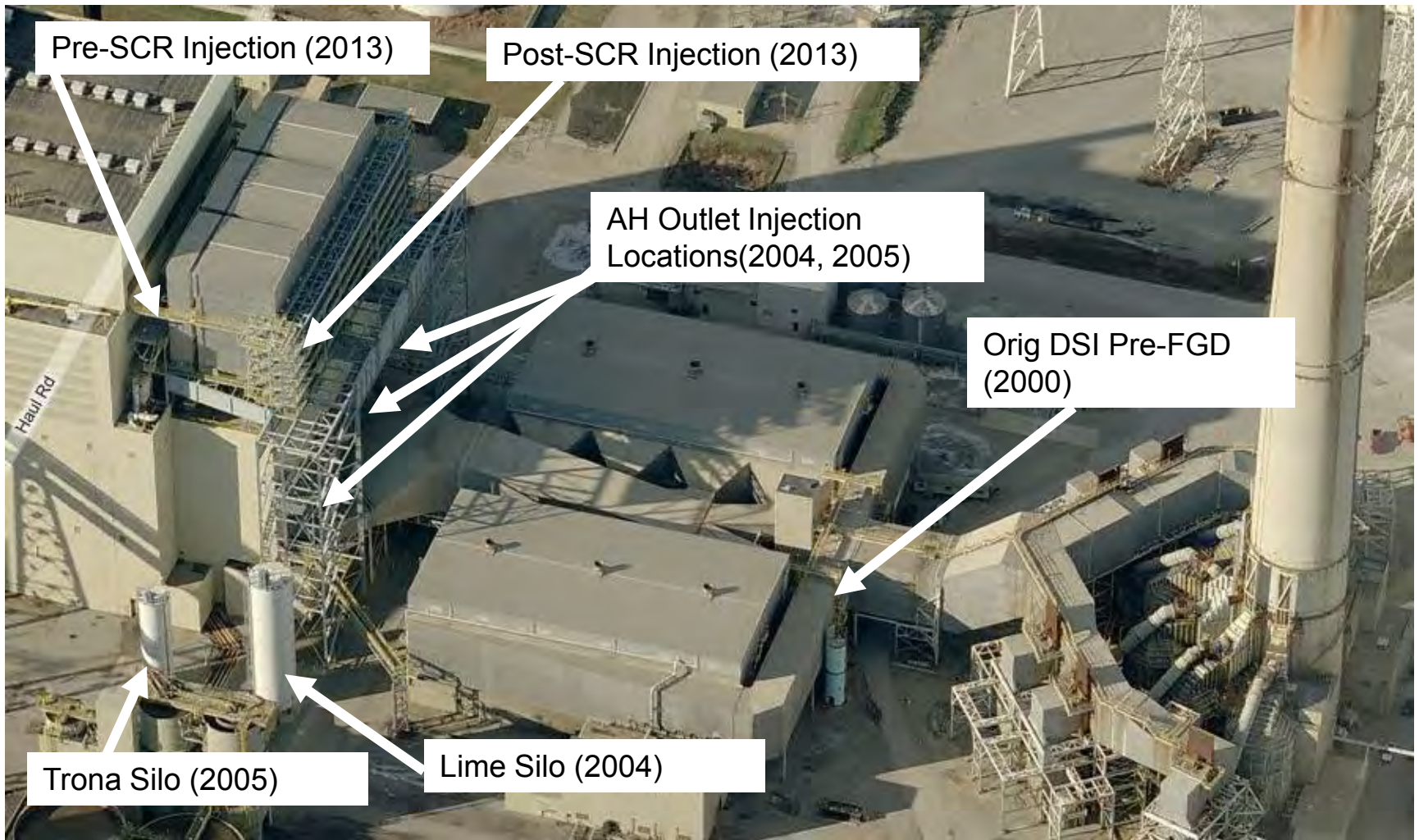
EVALUATE POTENTIAL SCR & BOP IMPACTS AND BENEFITS

- Consider Testing
 - Single duct testing could prove concept
 - Test Location – Depends in Ppart on objective

CASE STUDY

- Zimmer Power Station
- Moscow, Ohio
- 1440 Mw Gross
- Worlds Only Nuclear to Coal Conversion
- In Service 1991 with Wet FGD
- SCR Added 2004

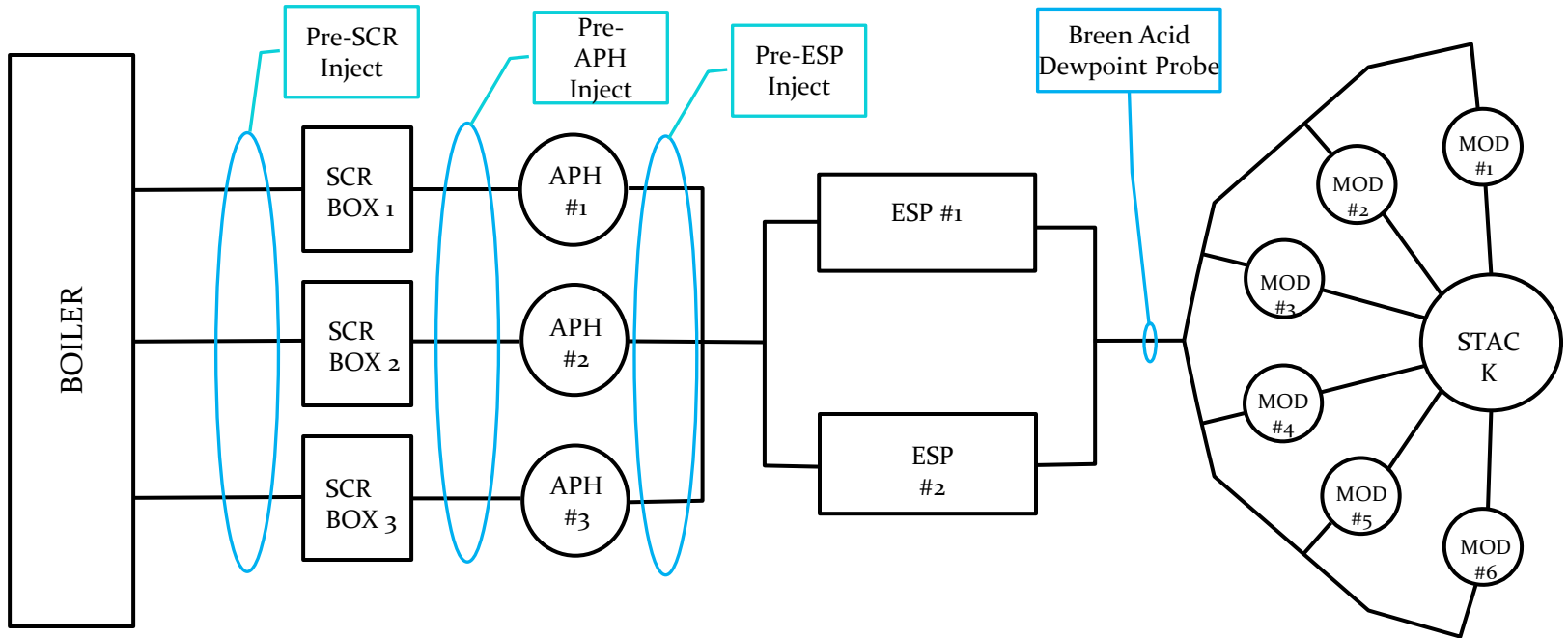
Zimmer DSI Systems History



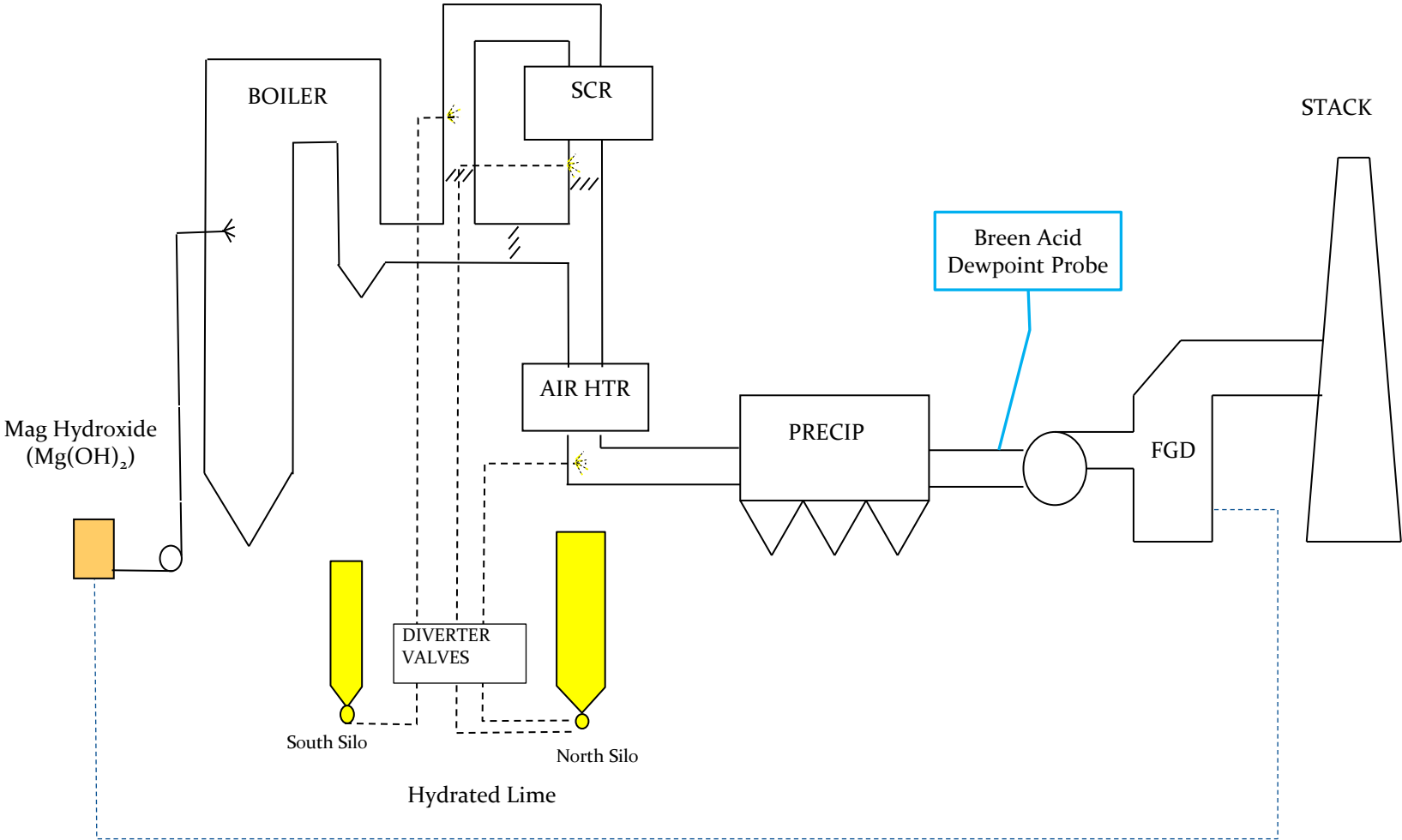
PRE-SCR INJECTION

- Initially Installed to resolve APH Pluggage Problem
- Location Selected for Simplicity
- Initially Injected Continuously Pre-SCR
- Added Post-SCR/ Pre APH Injection
 - Switched to Dual Injection
- Currently Inject Pre-SCR only at Low Load

Zimmer Power Station AQCS Config and Sorbent Injection Locations



Zimmer SO₃ Mitigation Systems



NH₃ INJECTION NOZZLE AND DELTA WING MIXERS (4 Per duct)



Diverter Valves



EFFECT ON SCR OPS

- Lowered Min Temps by >30F
 - Allows significant lower Min Load
 - Not require Low Load Gas Temp Mods
 - Based on Reducing SO₃ to ~5ppm @SCR Inlet
 - Currently Use Tiered DeNO_x @ Lower Loads
 - Can Likely Push to Lower Temps

CATALYST IMPACTS

- No Accelerated Catalyst Deactivation
- Slight Catalyst CaO Increase
- No Catalyst Pluggage
 - From Buildups or Ash/Lime Falls
- No Increased Catalyst Erosion
- No Deposits after 6 Month Outage w/o Layup Air heating thru Winter Season
- No Negative Impacts on Hg Oxidation

OTHER BOP EFFECTS AND FINDINGS

- Elimination of APH Fouling for 5 Years
- Permits More HR Benefit @ Low Load
 - Elim need for APH Air Side Bypass
 - Reduced Combust Air Pre-Heat >> Lower SCR In Temps
- Proportionally Less Sorbent Needed at Low Load due to lower SO₃ at Low Load
 - Case Specific
- HCl Capture more efficient w/ Pre SCR Injection
- SO₃ Capture more efficient w Post SCR/ Pre APH

SORBENT MIXING

- Sorbent Mixing Critical
 - More Important near MOT/ MIT
 - Need to good coverage to prevent localized ABS formation
- Similar Issues as NH_3 Mixing
 - Added Erosion & Buildup Potential
 - Practical Limit on Number of Lances

OTHER CONSIDERATIONS

- DSI System Redundancy
 - Silos, Feeders, Distribution Piping, Lances, Etc
- SCR Bypass Duct & Dampers Config & Ops
- Controls & Operating Procedures
- Econ Gas or Water Bypass for SCR Inlet Temp Control
 - Reduced Maintenance or Eliminate Need for
- Preheat Coil Operation
- Ash Sales (Chloride Limits, Calcium Limits)

SUMMARY & CONCLUSION

- So Far No Negatives
- Significant Unit Turndown Improvement
- Air Heater Fouling Elimination
- Additional Advancements Under Evaluation