REINHOLD ENVIRONMENTAL Ltd.

2014 APC Round Table & Expo Presentation

July 14-15, 2014, in Louisville, KY / Hosted by LG&E/KU

DSI & ACI System Design and Performance for Continuous Emissions Compliance

2014 APC Conference

Mark Thomas & Associates Consulting, LLC

DSI & ACI System Design and Performance for Continuous Emissions Compliance

- New Regs will prompt DSI & ACI Sys improvements
  - Most Current DSI Systems Primarily Designed for SO_3
  - Many Newer DSI systems for SO_3, Hg/PAC Support
  - Some New DSI Systems are built for SO2 & HCl removal
  - Many exist ACI systems must meet higher Hg removal targets

Primary Areas for Improvement

- Performance
- Reliability & Redundancy
- Co-Benefits – Maximize
- BOP Impacts – Minimize
- Sorbent Quality & Supply

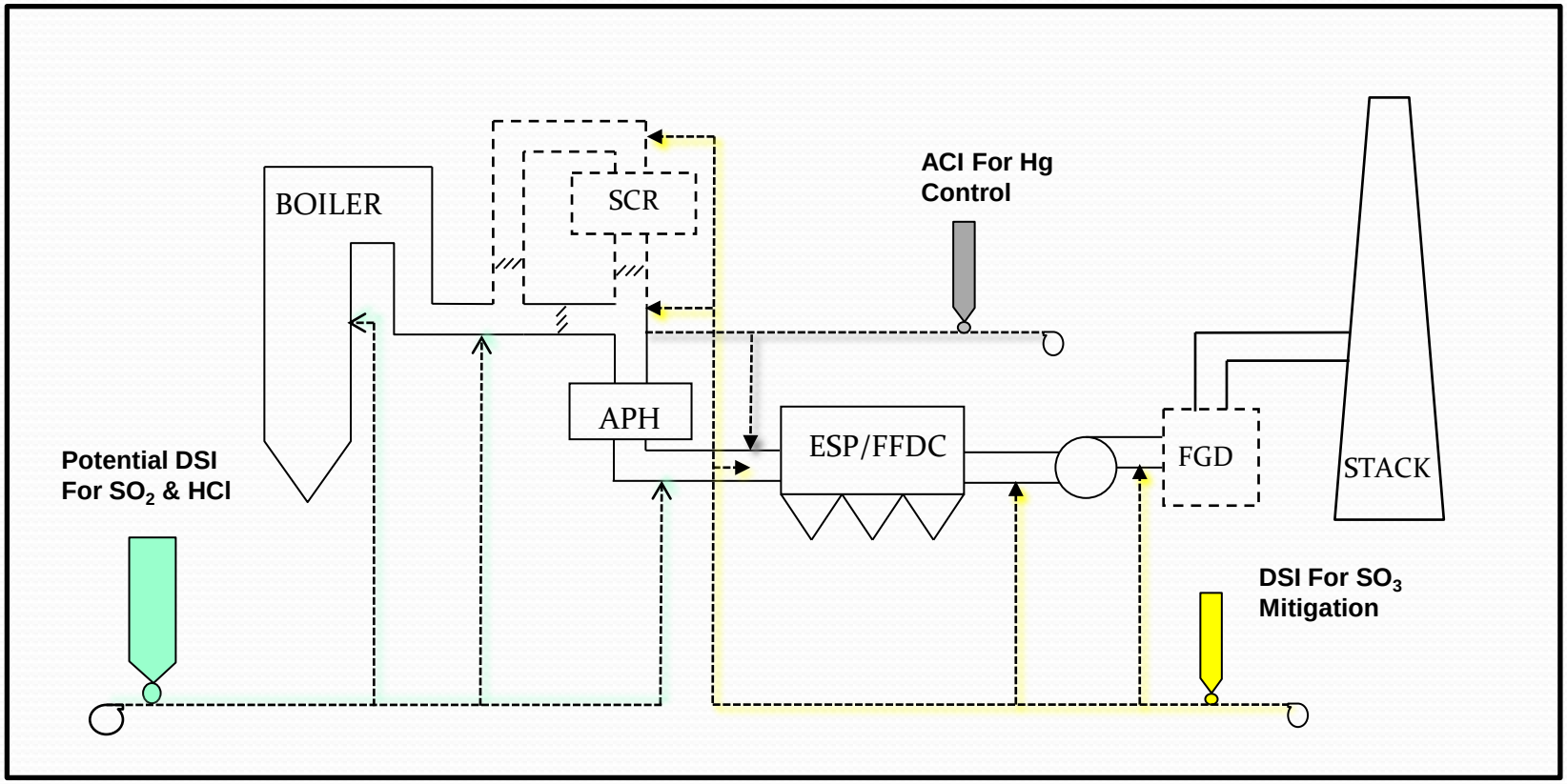
Performance Improvements Needed for DSI Systems

- Higher removal efficiencies & higher sorbent feeds
- More efficient Sorbent utilization
- Better understanding of Multi Pollutant-Removal
- Starts with good system design
  - Injection Location (s)
  - Sorbent Dispersion & Mixing
  - Sorbent Type & Quality

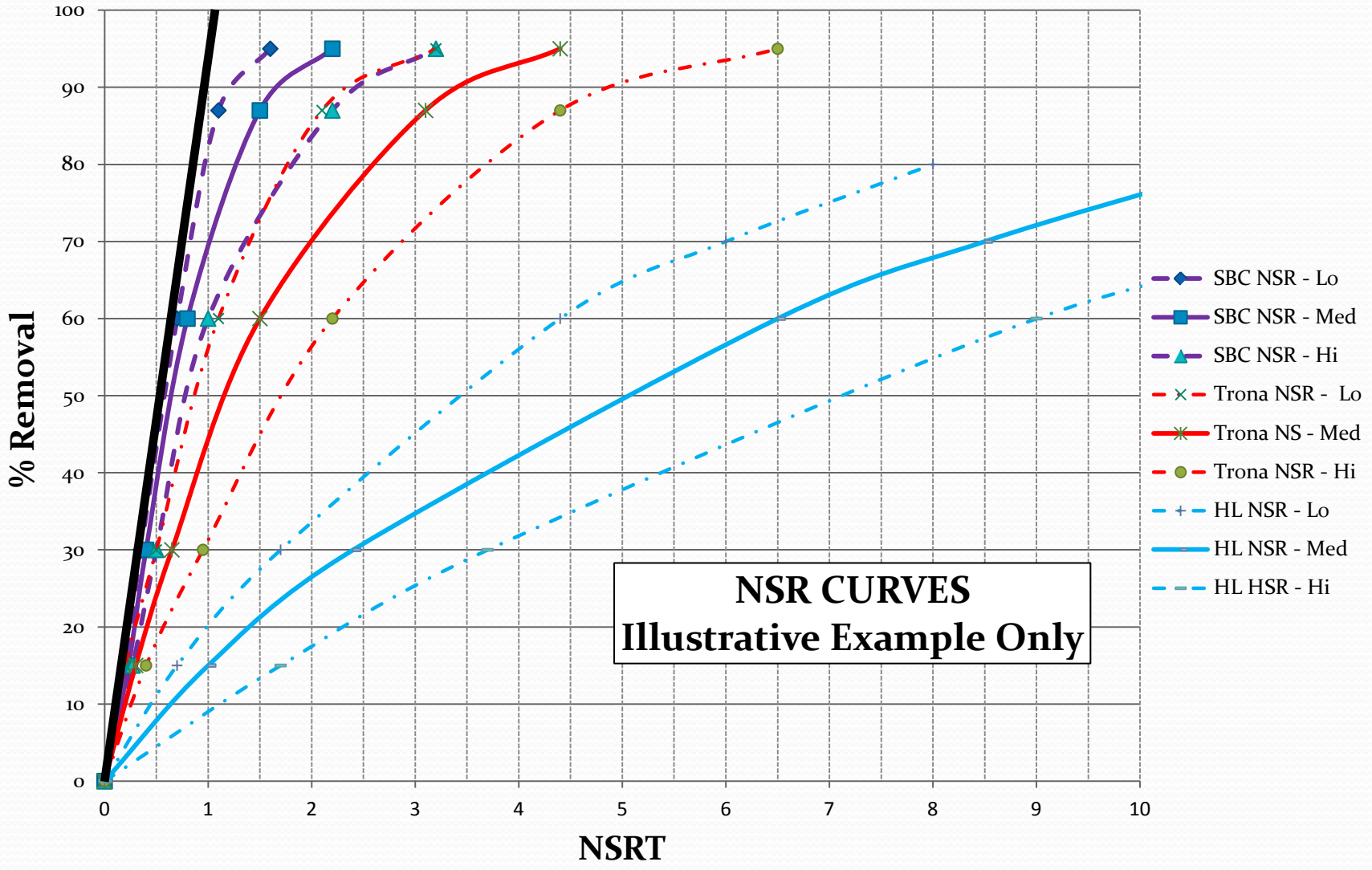
Performance Improvements Needed for DSI Systems

- Testing and analysis often needed to determine
  - Tests must be well planned.
  - Test methods –Continuous vs Periodic Sampling
    - Pro's & Cons to both
    - At times don't agree
  - Injection location(s) vs Sample Location
    - Stratification effects from fuel, sorbent injection, etc very often misleading
    - Not easy to test for
  - Test conditions
    - Unit load, fuel consistency, other transients
    - Ambient conditions during test impact SO_3, HCl, Hg removal

POTENTIAL DSI & ACI INJECTION LOCATIONS



DSI Performance – NSR Curves



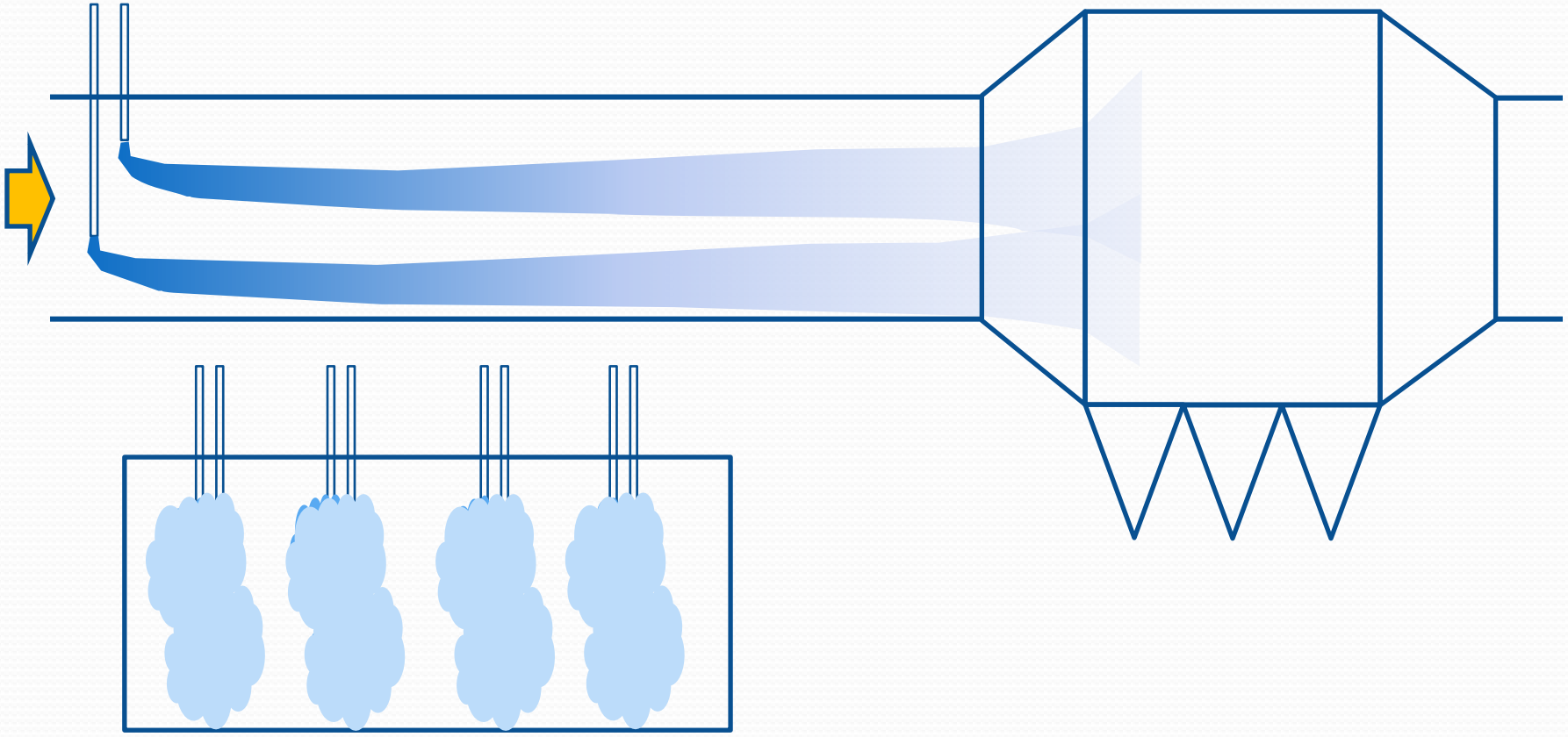
DSI Material Handling Challenges with Higher Sorbent Feed Rates

	Rough Estimate of Truck and Rail Loading and Delivery Requirements						
Unit Size	No. Units	Control	Feed Rate (Ton/hr)	Daily Feed (TPD)	Qty Trucks / Day	No Rail Cars/Day	
100	1	SO_2	1 - 5	24 - 120	1 - 5	0.2 - 1.2	
100	1	HCl	1 – 6	24 - 144	1 - 6	0.2 - 1.4	
100	2	HCl	2 – 12	48 - 288	2 - 12	.5 - 2.9	
100	4	HCl	4 - 24	96 - 576	4 - 24	1.0 – 5.8	

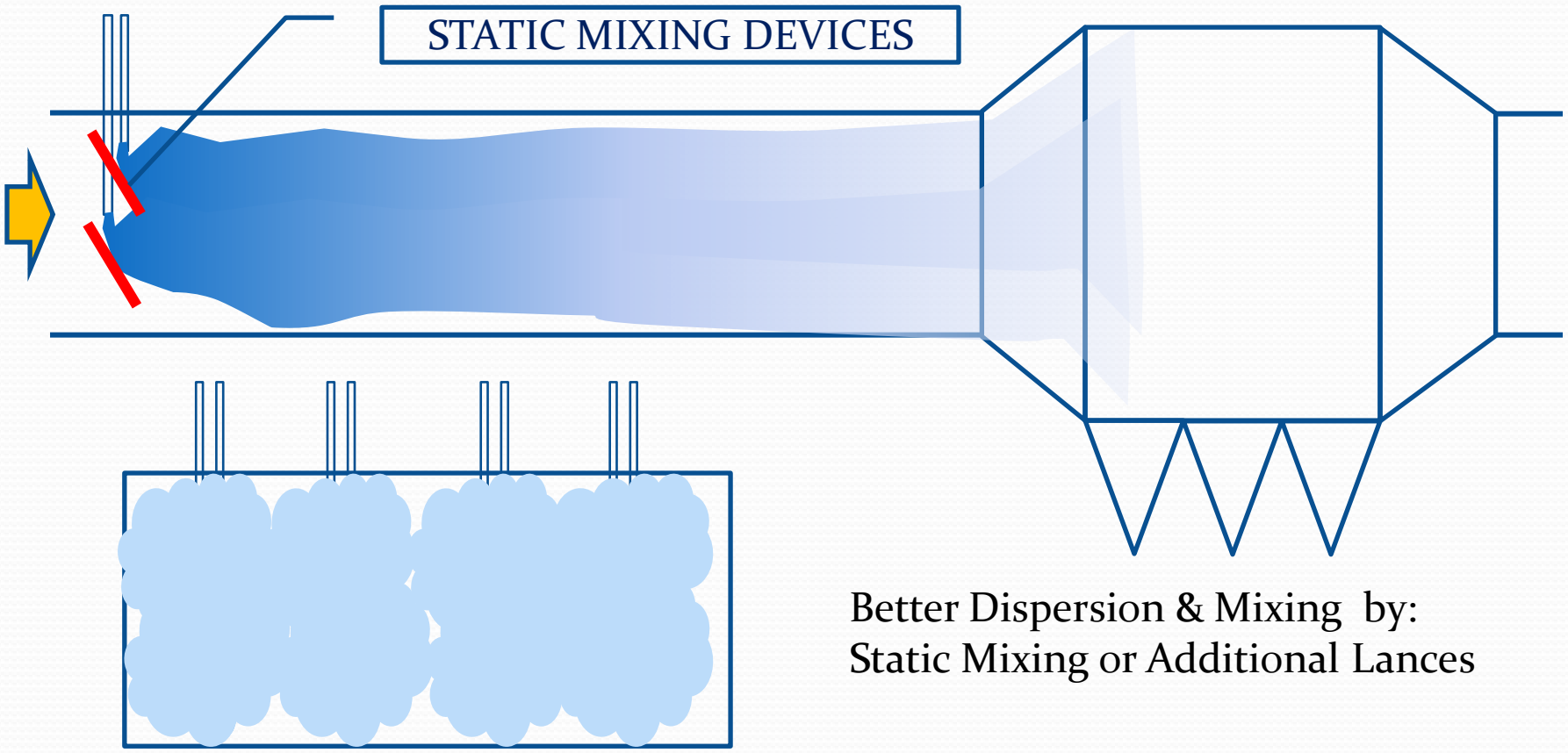
Better Dispersion & Mixing Critical for improved performance

- Sorbent Utilization can be reduced by >50%
- Target Removal % can be improved
- Same Principle for ACI and DSI
- Good DSI Dispersion for SO_3 Prior to ACI injection reduces PAC injection requirements
- Good sorbent dispersion can minimize ESP impacts

Dispersion & Mixing - Current Systems (Likely above Avg)



Dispersion & Mixing - Improved Systems



Better Dispersion & Mixing by:
Static Mixing or Additional Lances

Reliability & Redundancy Improvements Needed for DSI & ACI Systems

- Need more consistent DSI System operation
- Simplified maintenance
  - Shrouded lances vs lance purge systems
  - Hoses vs elbows vs Tee-Bends
- Need for equipment redundancy
  - Even more reason for simplified systems
- Convey air properties critical
  - Humidity, Temp, Velocity
  - Compressors vs PD Blowers
  - Consider using compressed plant air
  - Tower dryers vs air refrigeration units vs dessicant wheel

System Design Considerations

- Mixing & Distribution
- Single Injection vs Multiple Injection Locations
- Single Sorbent vs Dual Sorbent
- Single Silo vs Multiple Silos
- Feed & Convey Systems
- Convey Air Temperature & Humidity Control
- Redundancy

Consider Potential Co-Benefits and Balance of Plant Impacts -

- Integrated Holistic Assessment Critical
  - Fuel Flexibility
  - Corrosion
  - APH Pluggage Effects
  - SCR & Unit Turndown
  - Baghouse Protection vs Blinding
  - HAPs/ HCl/Hf effects on FGD
  - SCR Catalyst Protection vs Catalyst Degradation
  - Furnace Slagging
  - Plume and or ESP Opacity
  - Ash Disposal & Sales

Consider Potential Co-Benefits and Balance of Plant Impacts -

- Testing often required to 'know' for sure
  - Test Injection location & dispersion will impact conclusions
  - Test Injection system should be well thought out and designed
  - Often need short term and longer term test for BOP impacts
- Develop test plan from holistic but practical perspective
  - Consider all important impacts.
  - Good judgment needed
- May need to design with potential future mods in mind
  - Careful be practical

DSI Impacts on Hg Emissions

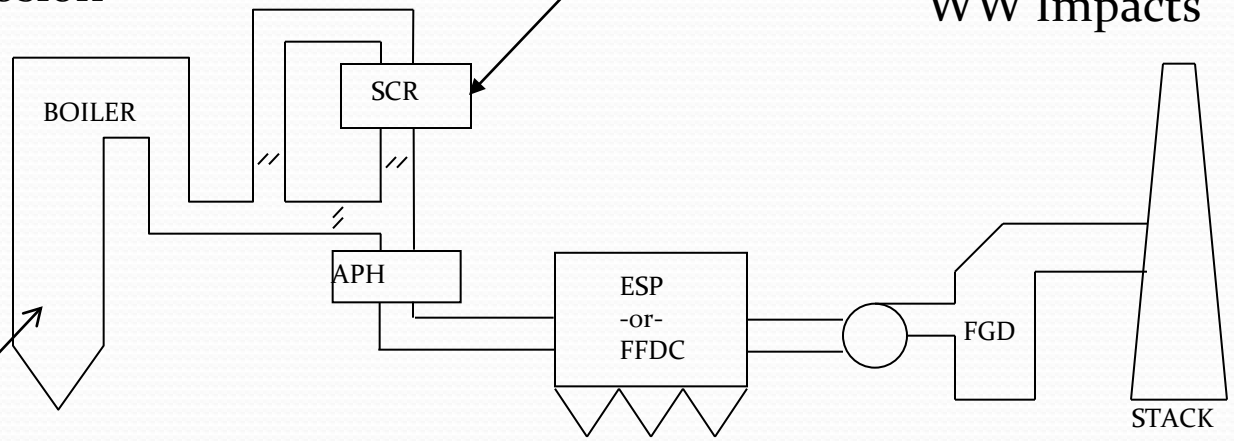
- Potential for Reduced Hg Emissions
  - Reduced SO_3 Levels at ESP >> Increased ESP Hg Capture
  - Reduced SO_3 Levels @ APH >> Potential to reduce APH Gas Out Temps >> Increased ESP Hg Capture
- Potential for Increased Hg Emissions
  - Reduced HCl Pre-SCR >> Reduced Hg Oxidation
  - Potential Impacts to Catalyst Hg Ox Properties due to Catalyst Poisoning or Blinding
- Final results contingent on many factors

Chlorine & Hg Effects

BAD
Water Wall
Corrosion

GOOD
HCl (Halides)Oxidize Hg

BAD
Chlorine Corrosion
WW Impacts



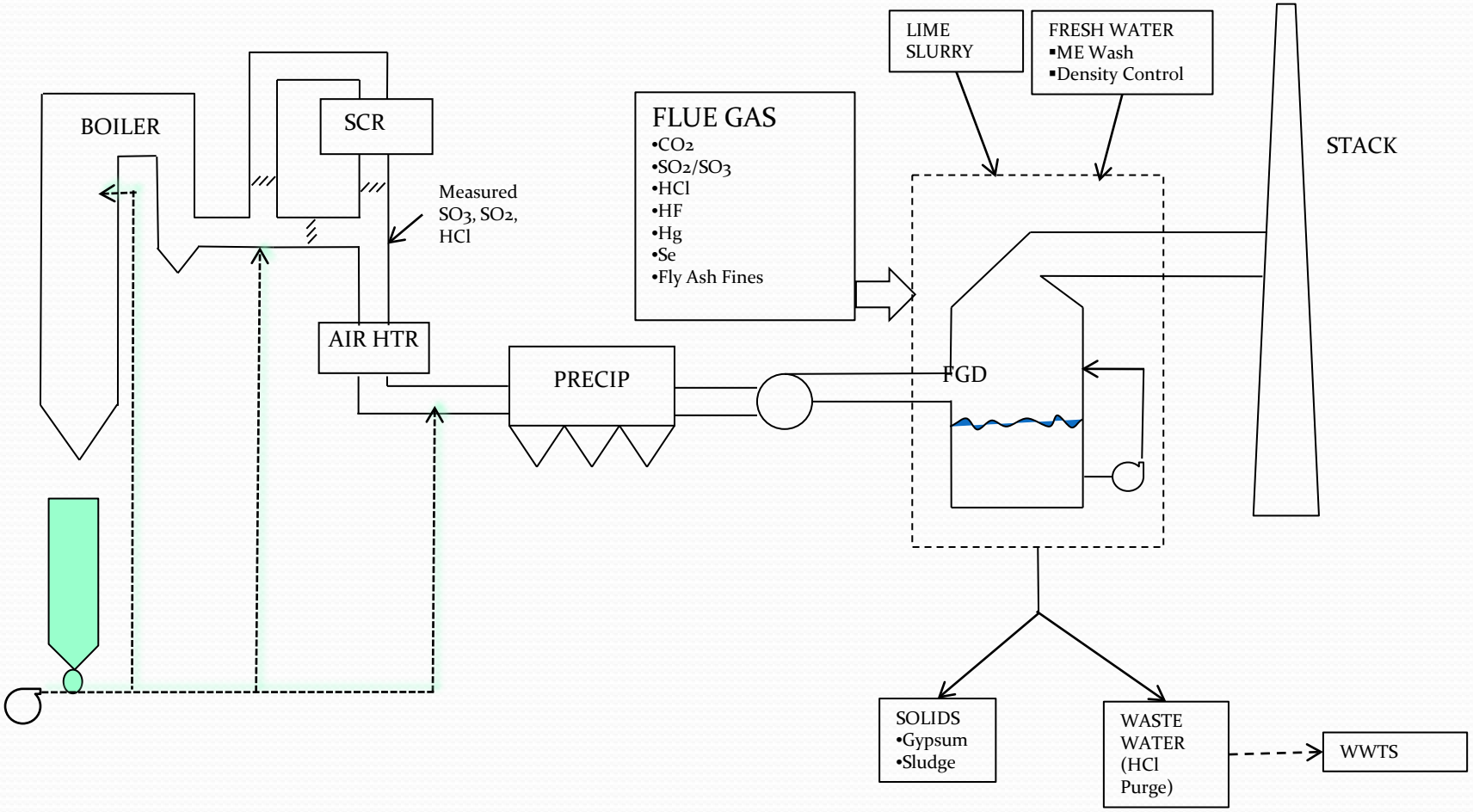
Solid
Chlorine
from Coal

Gaseous Chlorine

Dissolved Chlorine
in Scrubber Bleed

BENEFIT OF HCL REMOVAL w/ DSI

Basic FGD Mass Balance



Sorbent Quality & Supply

- Improved Sorbents are still being developed
- Quantities limited at times
- Need clearer picture of future supply
- Select Sorbent & Design system with this in mind
- Must carefully consider ramifications of long term supply contracts.

Conclusion

- Know Objectives
- Know Options
- Design with Potential Future Developments Modifications in Mind – Think Ahead
- Spend $ where needed
- Test to prove confirm if possible
- Use integrated/ holistic approach