# REINHOLD ENVIRONMENTAL ®

# 2022 Reinhold/PCUG Round Table Presentation

## Hosted by Duke Energy in the Charlotte Sheraton/Le Meridien Hotel, Charlotte, NC on June 27-28, 2022

# Cost Effective DSI System Retrofits for Improved System Performance

## 2022 NOx RT

Mark Thomas

Mark Thomas & Associates Consulting, LLC

# Background & Perspective

- 32 Years of Utility Power Plant Experience
  - Ohio Edison (Co-Op)
  - Cincinnati Gas & Electric > Cinergy > Duke Energy
  - Mark Thomas & Associates Consulting since 2011
- 23 Years of SO3 Mitigation Experience
- 17 Years of SCR & Catalyst Experience
- DSI System Design, Testing & Performance Evaluations, O&M
- Used Most Available Reagents
  - Calcium (Hydrated Lime, Limestone, Cao)
  - Sodium (Trona, Sodium Bicarbonate, SBS) (Wet & Dry)
  - Magnesium (Mag Hydroxide (Wet & Dry), Magnesium Sulfate (Wet)
- Various Injection Processes & Locations
  - Wet & Dry
  - Furnace to FGD Inlet
  - Coal Additives
- Work with but Independent from any Sorbent or DSI System Provider

# DSI System Performance Improvements

- Minimize Sorbent Utilization
- Maximize Target Pollutant Capture
  - SO3, SO2, HCl, Hg
- Maximize Reliability & Consistent Operation
- Minimize Maintenance
- Maximize Flexibility for BOP Co-Benefits

# Potential Balance Of Plant Improvements

- Maximize BOP Co-Benefits
  - SCR Min Load Operation
  - APH
    - Reduce APH Pluggage
    - Reduce APH Corrosion
    - Heat Rate Improvements
  - MATS / Hg Control
  - FFDC
    - Bag Protection
  - ESP
    - Improve Capture

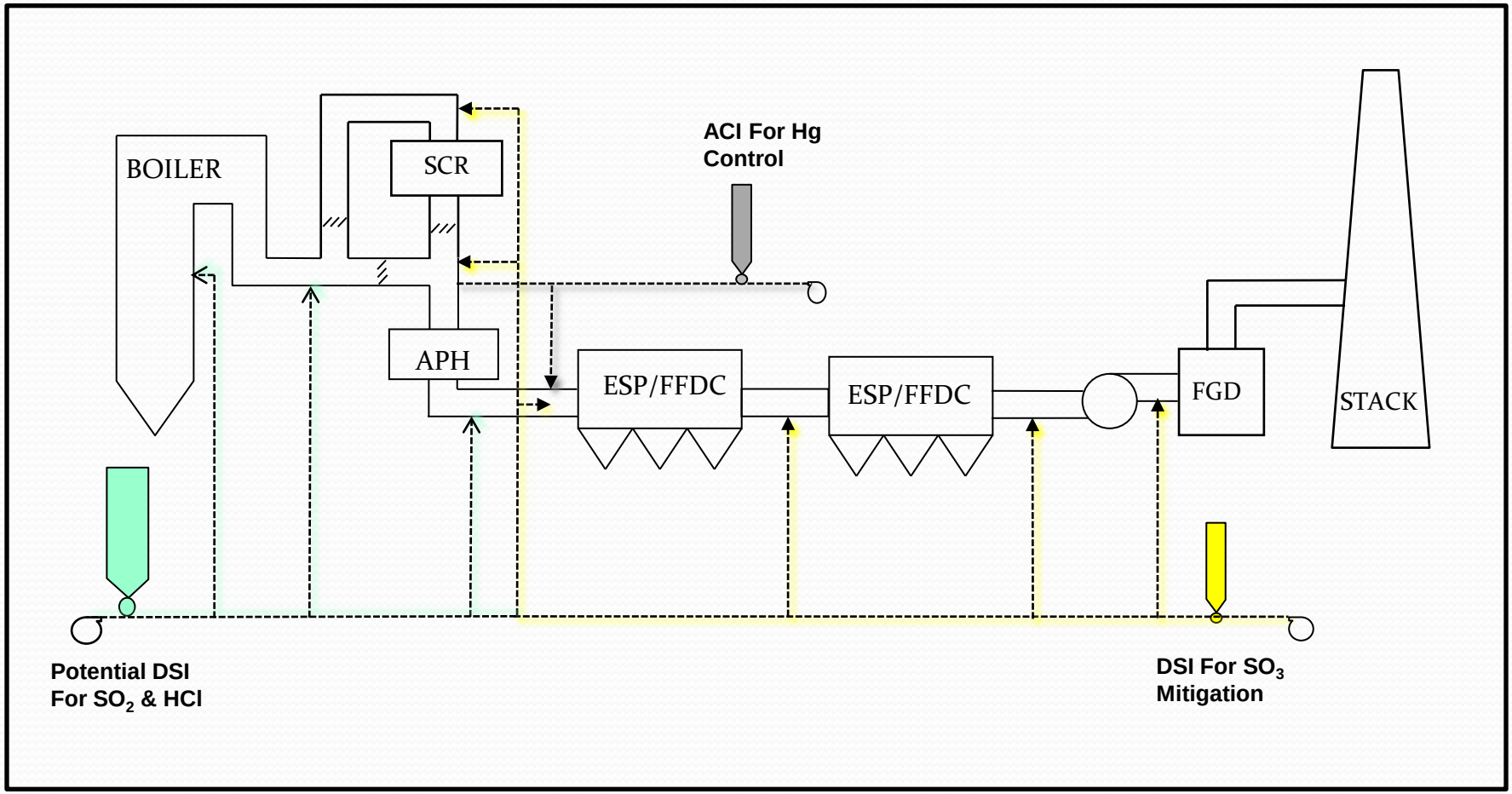
# Minimize BOP Impacts

- SCR Catalyst Impacts
- APH Pluggage Potential
- Fly Ash Impacts
  - Na, Ca, Cl, C/LOI
  - Sorbent Layout in duct
- ESP
  - Ash resistivity
  - Perf Plate Pluggage (Trona)
  - Uneven Sorbent Loading
- FFDC
  - Uneven Sorbent loading, unprotected areas

# Plant Performance Objectives

- Performance, Maintenance & BOP Issues Interrelated
  - Ex: Plugged & Corroded lances impact dispersion and can overload ESP zones >> unnecessary opacity issues and excessive sorbent feed
- Flexibility becoming more important
  - Drives, contributes to need for cost effective advances
- Ability to make changes online can be beneficial

# POTENTIAL DSI & ACI INJECTION LOCATIONS



# Need For Cost Effective New & Retrofit Solutions

- Cost Savings Generally Desirable
- Some plants have nearer term closure dates
- Can use cost savings to add redundancy / flexibility
- Can use cost savings to improve other plant systems

# Overview of Cost Effective DSI Retrofits

- Improved Feed System
- Distribution & Splitting for Added Injection Locations
- Improved Dispersion & Mixing
- Convey & Unloading Air Quality

This presentation will focus on options that work and are cost effective.

# DSI FEED SYSTEMS – STANDARD DESIGN


# DSI FEED SYSTEMS - SIMPLIFIED

Single Feeder

Vent to Top of Silo – No Cartridge Filters

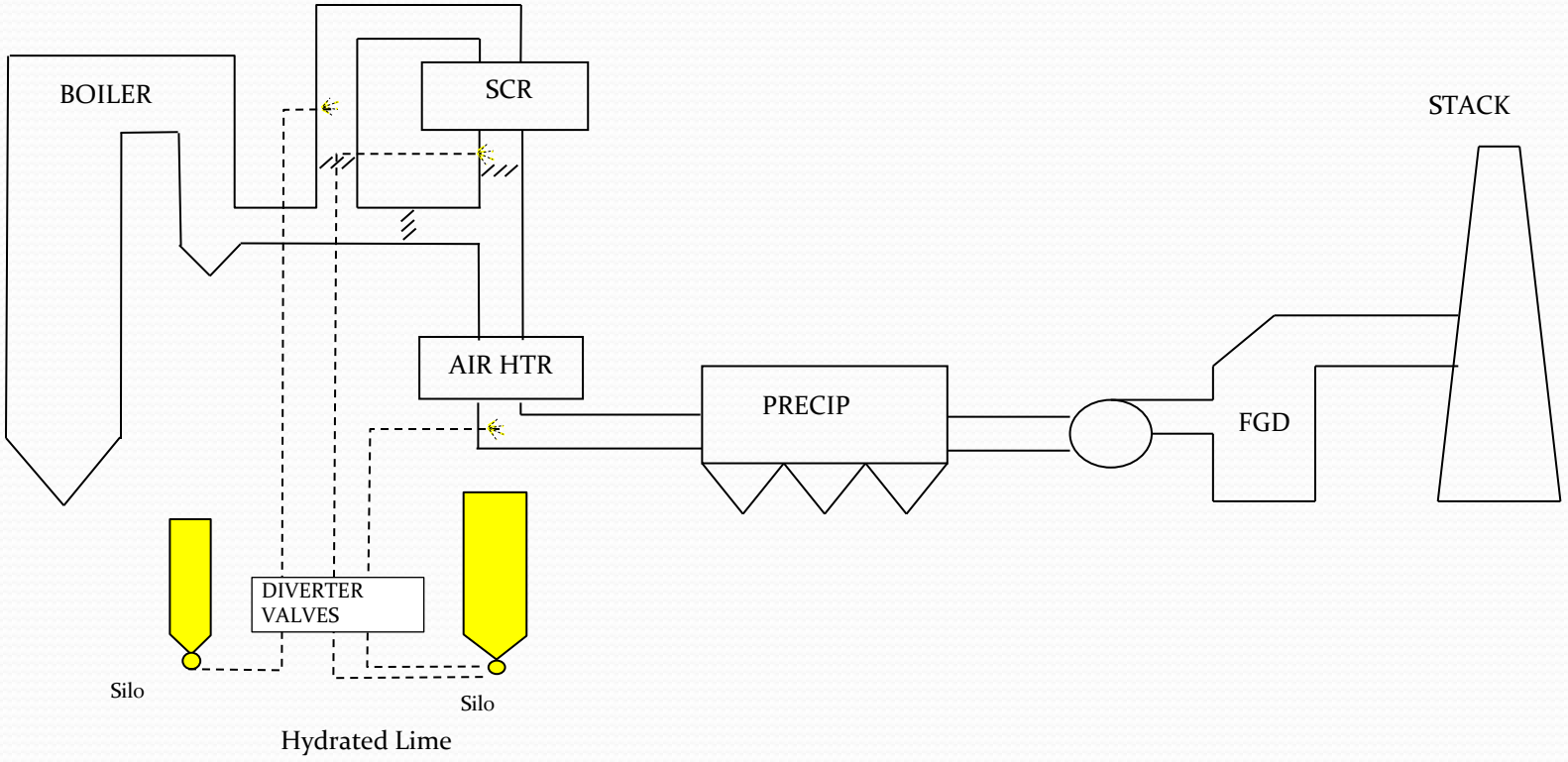
No Aeration in Weigh Bin

# DSI FEED SYSTEM IMPROVEMENTS

- Longer Fill Cycles
- Smoother LIW Signal
  - No Interference from Bag cleaning and blinding
  - Vent line maintains constant pressure
- Reduced Maintenance on Rotary Airlocks
- Self Clearing vent line
- Hose Connections for ease of cleaning and inspections

# DSI DISTRIBUTION & SPLITTER SYSTEMS

- Multi Point Injection
  - Drives the need for cost effective but high performing lances and feed systems

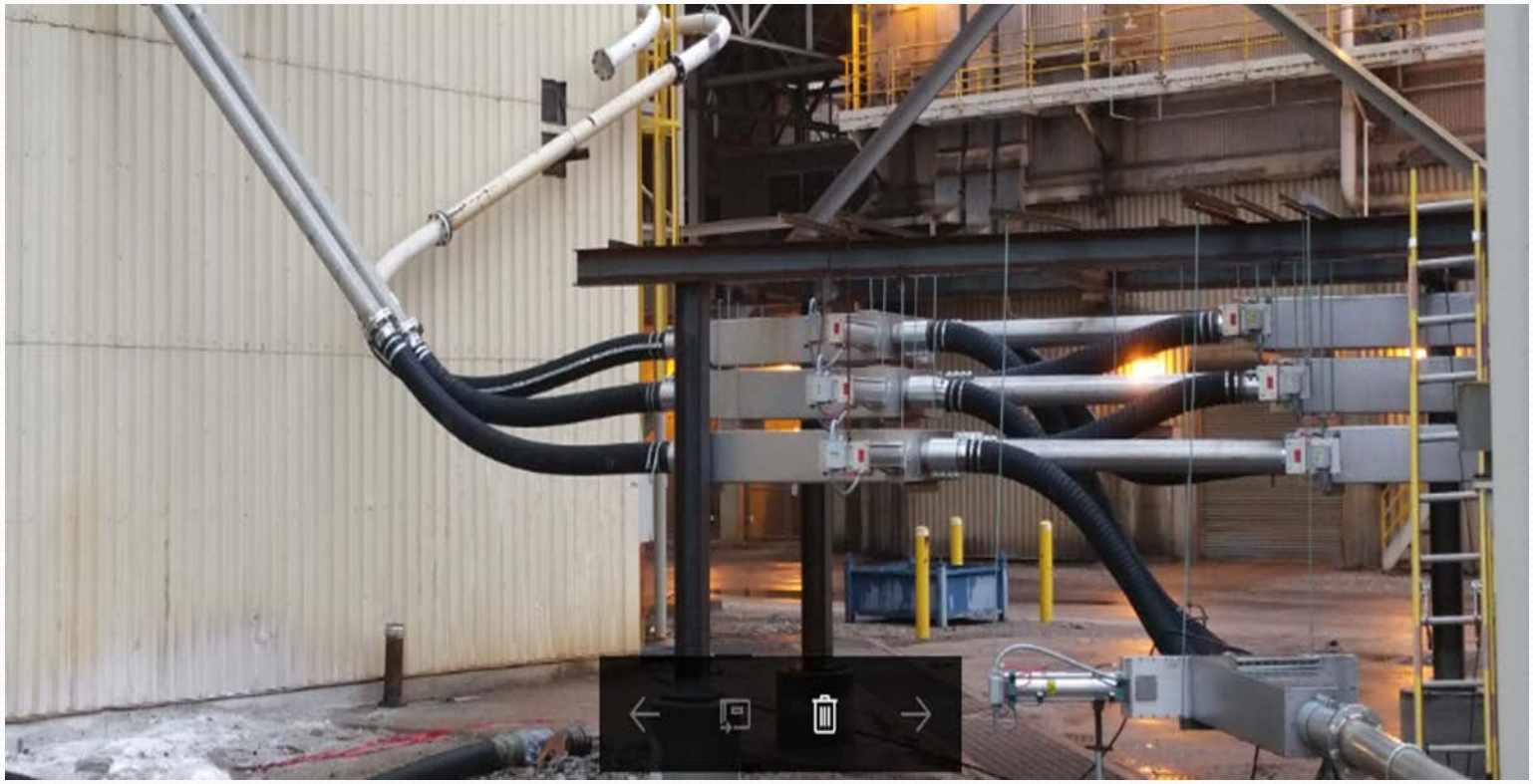


# Additional DSI System Advancements

- Use of Diverter Valves to feed alternate Injection Sites
  - Can be swap quickly to alternate injection grid location
  - Can be used to achieve redundancy for more critical application

# Additional DSI System Advancements

- Use of Diverter Valves to feed alternate Injection Sites
  - Can be swap quickly to alternate injection grid location
  - Can be used to achieve redundancy for more critical application



# SPLITTER DESIGN WITH INTEGRAL SIGHT GLASSES

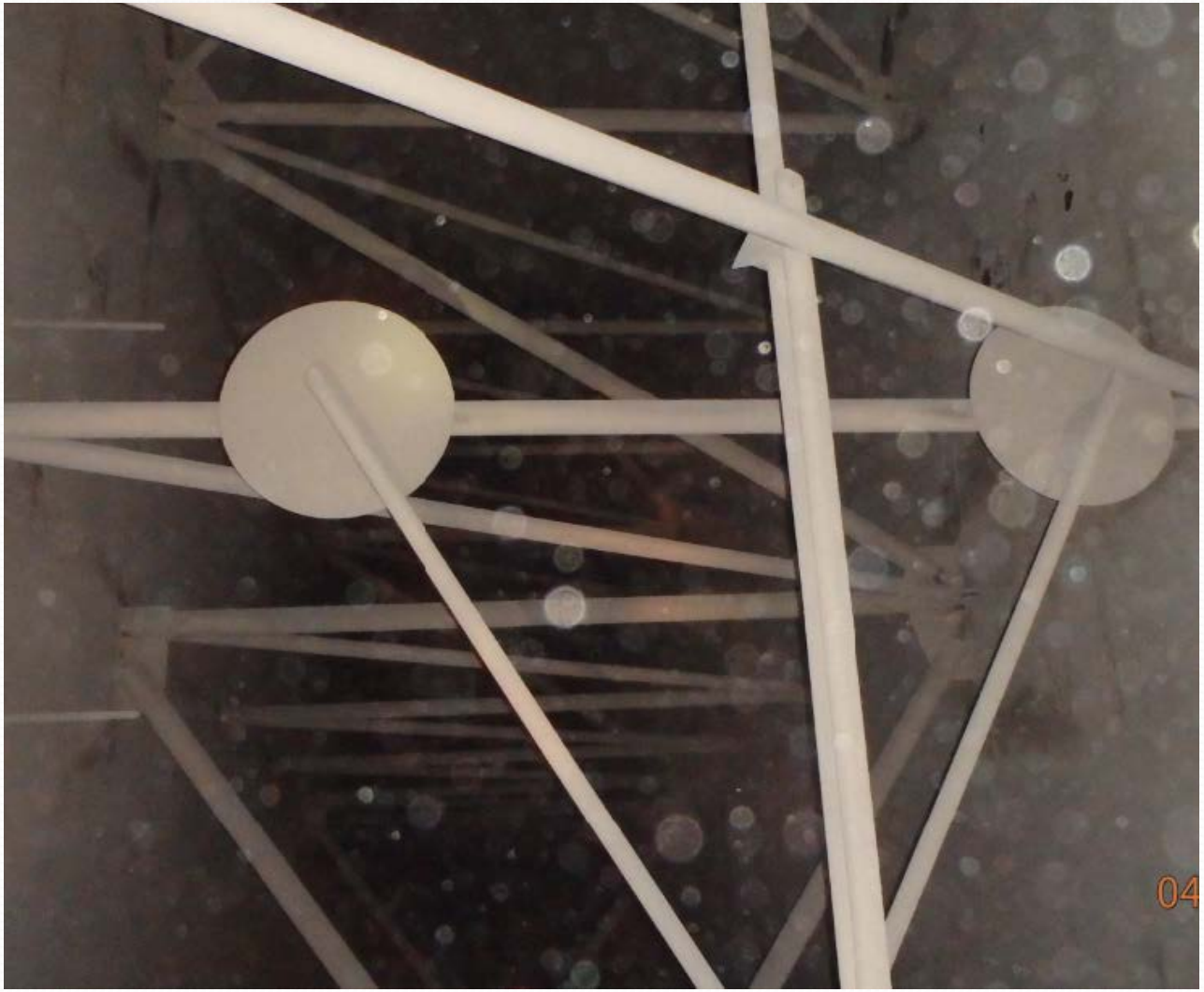
- Cost Effective
- Provides ability to easily see relative flows to each lance
- Splitter body less prone to surface rust & product clinging
- Easy to clean and replace sight glaass

# Typical Industry Standard Lance Design

## 2007 Lime Lances

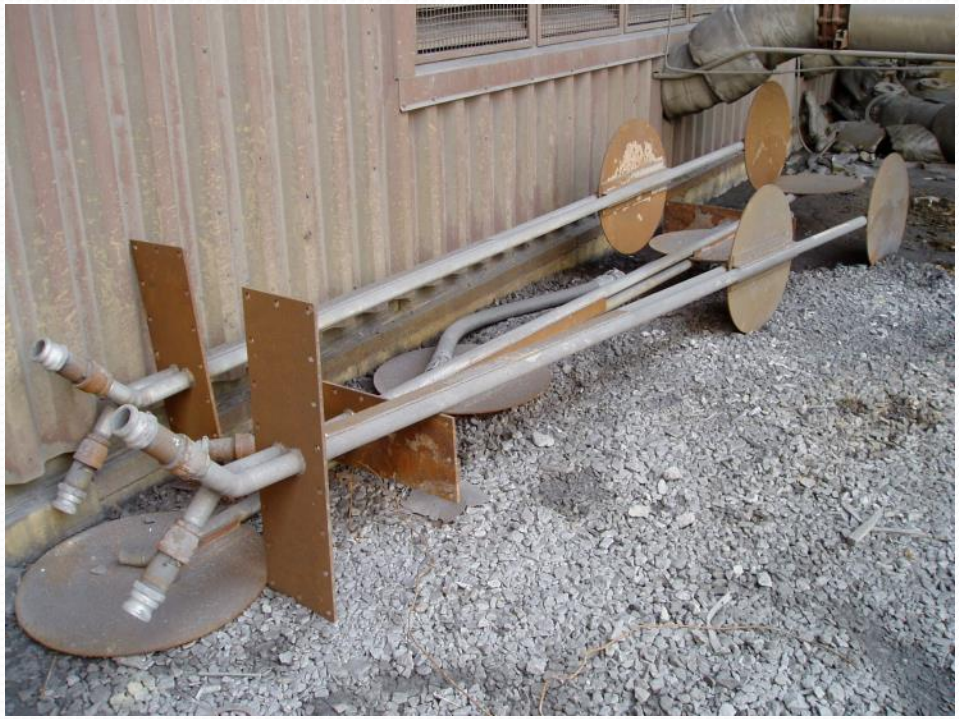

## 2012 Trona Lances

# Initial Lances with Integral Mix Plates 2000 Thru 2003



# Additional Early Generation Advanced Lances

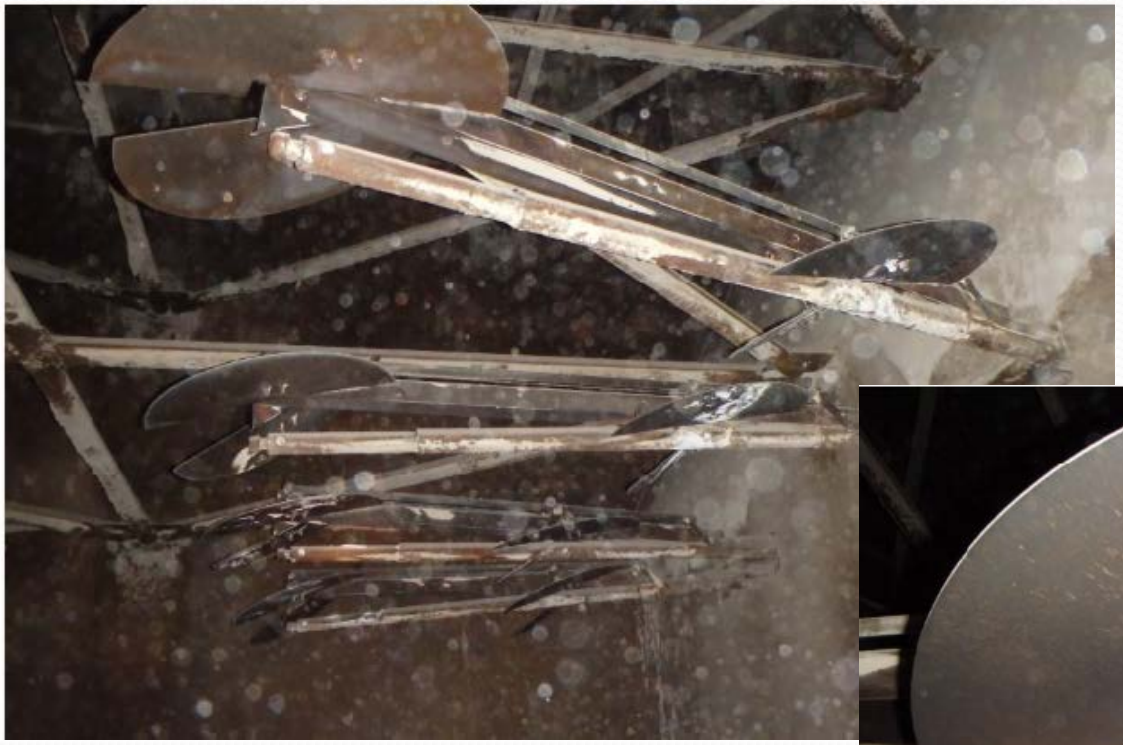
## 2004 Trona & Lime Lances



## 2005 Trona Lances

# Continued Development of Advanced Lances

## 2013 Lime Lances with Independent Adjustable Plates



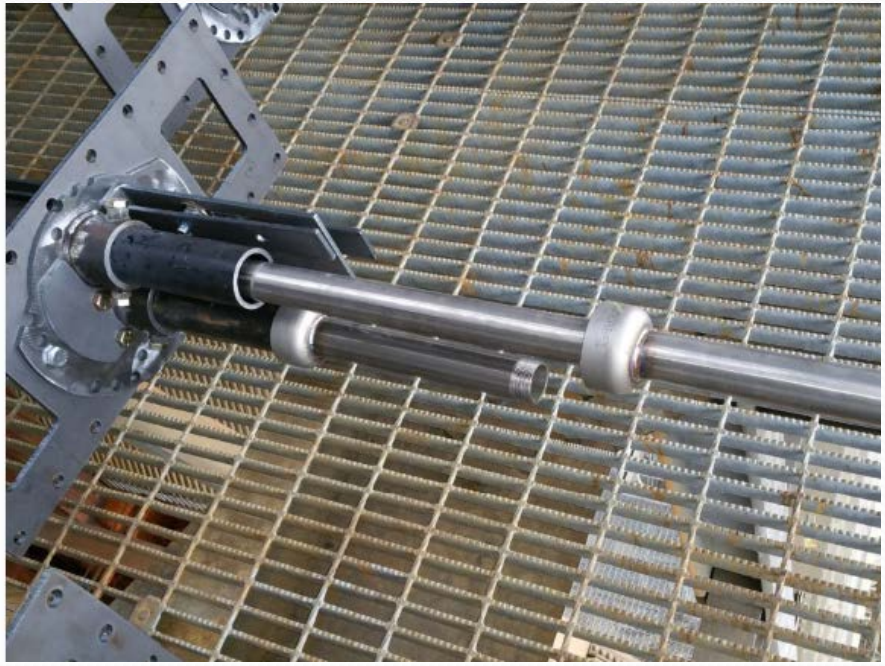
# Continued Development of Advanced Lances

## 2016 Lances

## 2017 Lances

# Continued Development of Advanced Lances

## 2018 DSI Lances – Adjustable Mix Plates & View Ports



Note: Lance removal requires no tools

# Continued Development of Advanced Lances

## 2020 – Current Lances – Adjustable Mix Plates & View Ports

Note: Lance removal requires no tools

# Benefits from Advanced Lance Designs

- Significantly Improved Dispersion
  - Currently up to 42 “ Diameter Mixing Plates
- Effective at Very Reasonable Fabrication Cost
- Easy go install thru rectangular ports
  - Existing ports can be used but require internal mixer attachment
- Can eliminate the need for internal scaffolding for installation or maintenance or modifications.
- Designed to be easily modified for future improvements
- Can install multiple lances in same port at different elevations
- Can be installed in any orientation

# Benefits from Advanced Lance Designs

- Designs can be customized for specific applications
  - Plate Tilt & (Rotation) Adjustable from duct exterior or interior
    - Can evaluate performance realtime
    - Can evaluate pressure drop
    - Can adjust to minimize erosion patterns on lances or on erosion induced by mixing plates
- Maintenance for lance checks drastically simplified.
  - Lance tube removal requires no tools
  - Can be removed and replaced in a few minutes
  - Lance tube protected from corrosion and excessive heat

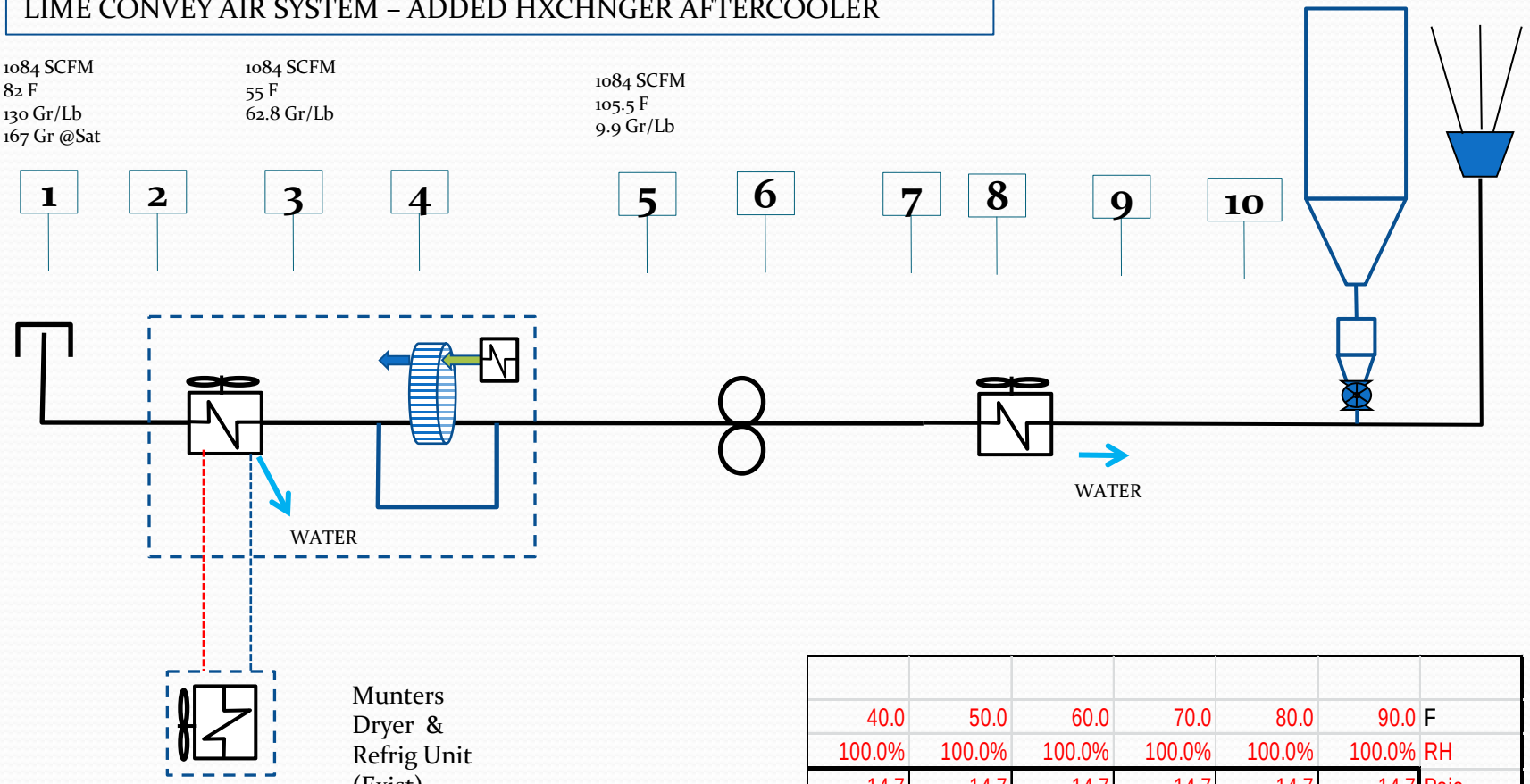
# AIR QUALITY IMPROVEMENTS USING DEHUMIDIFICATION SYSTEM

## LIME CONVEY AIR SYSTEM – ADDED HXCHNGER AFTERCOOLER

1084 SCFM
82 F
130 Gr/Lb
167 Gr @Sat

1084 SCFM
55 F
62.8 Gr/Lb

1084 SCFM
105.5 F
9.9 Gr/Lb




Munters
Dryer &
Refrig Unit
(Exist)

| | | | | | | |
|---|---|---|---|---|---|---|
| 40.0 | 50.0 | 60.0 | 70.0 | 80.0 | 90.0 | F |
| 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | RH |
| 14.7 | 14.7 | 14.7 | 14.7 | 14.7 | 14.7 | Psia |
| 36 | 53 | 77 | 110 | 156 | 217 | Gr/Lb |
| | | | | | | |
| 23.7 | 23.7 | 23.7 | 23.7 | 23.7 | 23.7 | Psia |
| 22 | 33 | 48 | 68 | 95 | 132 | Gr/Lb |

# Advancements Continue

- Thorough assessments important
- Know your current and possible future objectives
- Integrated/ Holistic Approach Critical
- DSI Experience is growing rapidly
- Past experience critical but past conclusions can be misleading

# QUESTIONS?