

Reinhold Environmental Ltd.



2010 NO_x-Combustion Round Table & Expo Presentation

February 8 & 9, 2010

Chattanooga, TN

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Dry Sorbent Injection Operating Experiences & Lessons Learned

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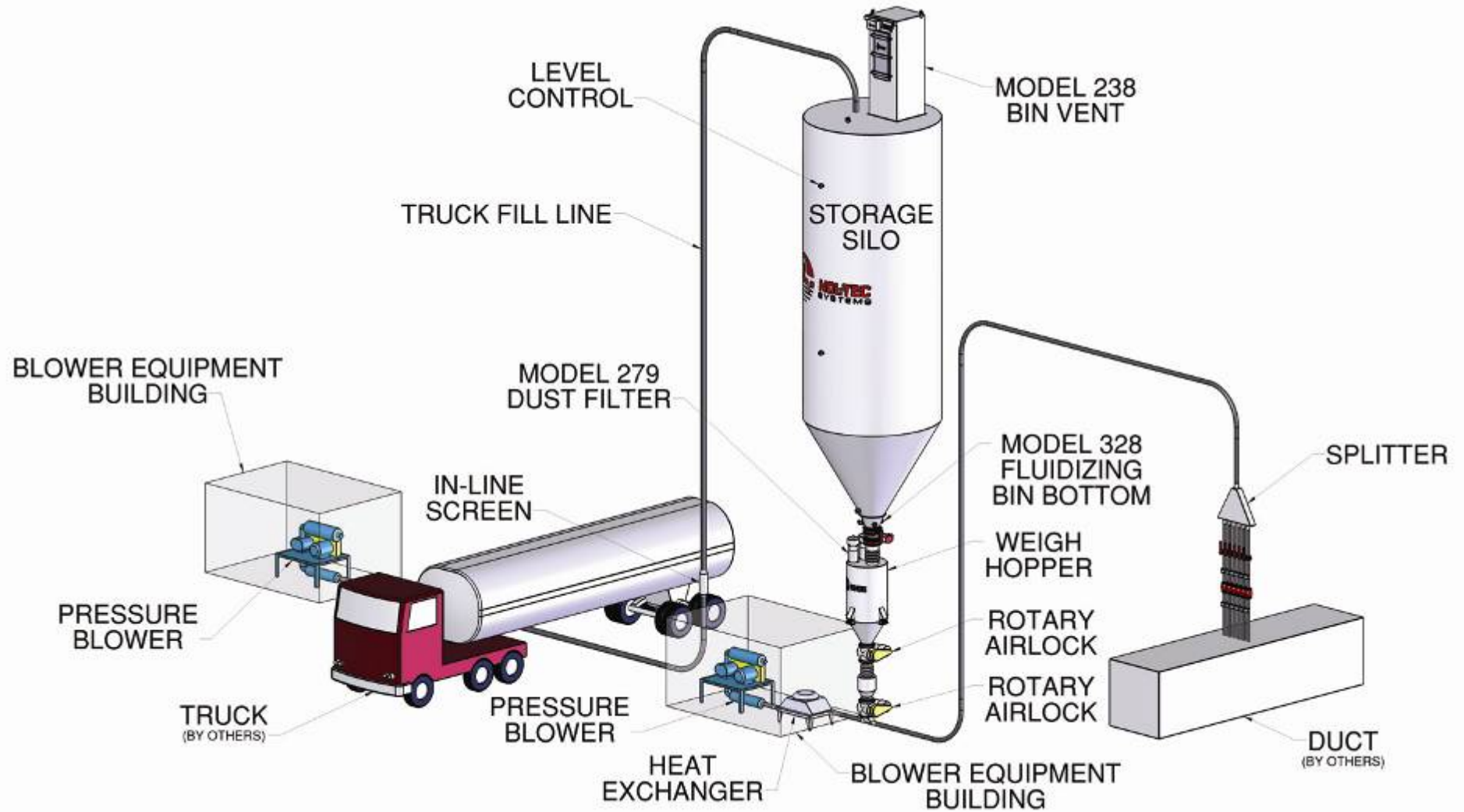
2010 NOx – Combustion Roundtable

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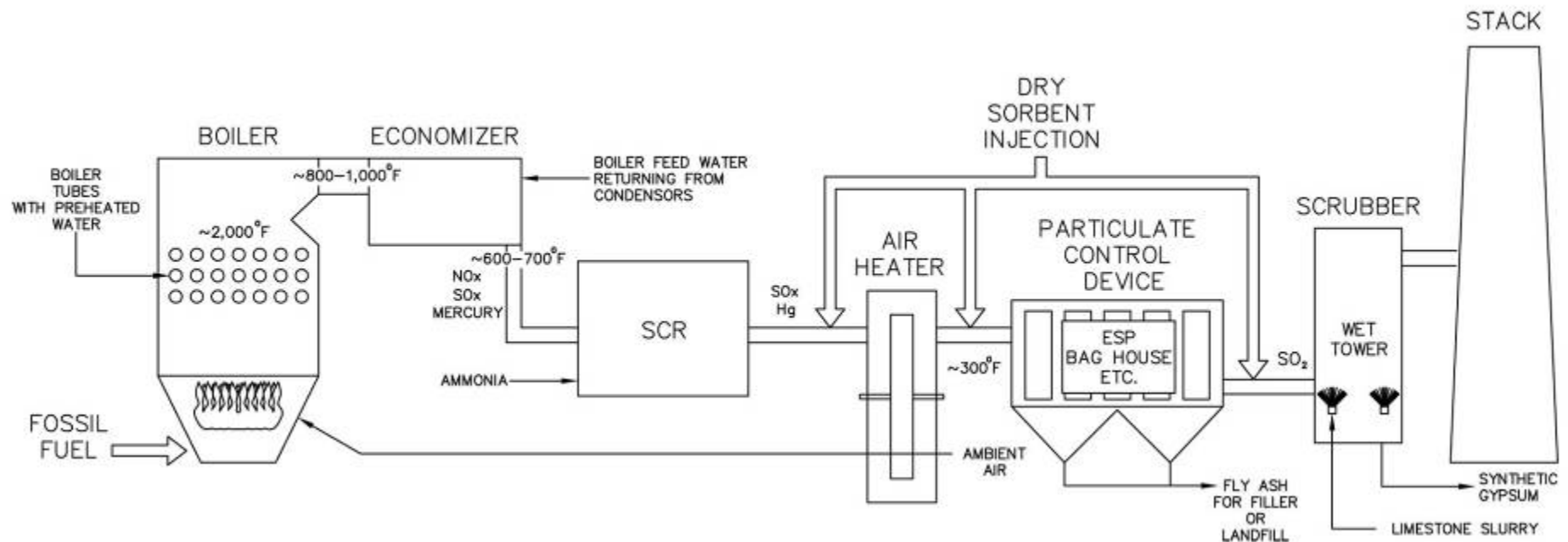
Coal-Fired Electric Generation Sorbent Injection

Typical Arrangement

Types of Sorbents

- Hydrated Lime
- Trona (Sodium Sesquicarbonate)
- Sodium Bicarbonate
- Powdered Activated Carbon (PAC)

Schematic – Typical Power Plant



Operating Experiences & Lessons Learned

- Typical Operating Issues
 - Plugging & Material Build-Up
 - Abrasiveness & Wear
 - Sorbent “Flow-ability”
 - Controlled/Consistent Feed Rate

Operating Experiences & Lessons Learned

- Plugging & Material Build-Up – Trouble Spots
 - Offloading to Silo Storage
 - Screen Plugging
 - Moisture
 - Elbows & Bends
 - Build-up & Plugging
 - Rotary Airlocks
 - Material Build-up & Squealing
 - Lances
 - Plugging
 - Wear/Fatigue/Breakage

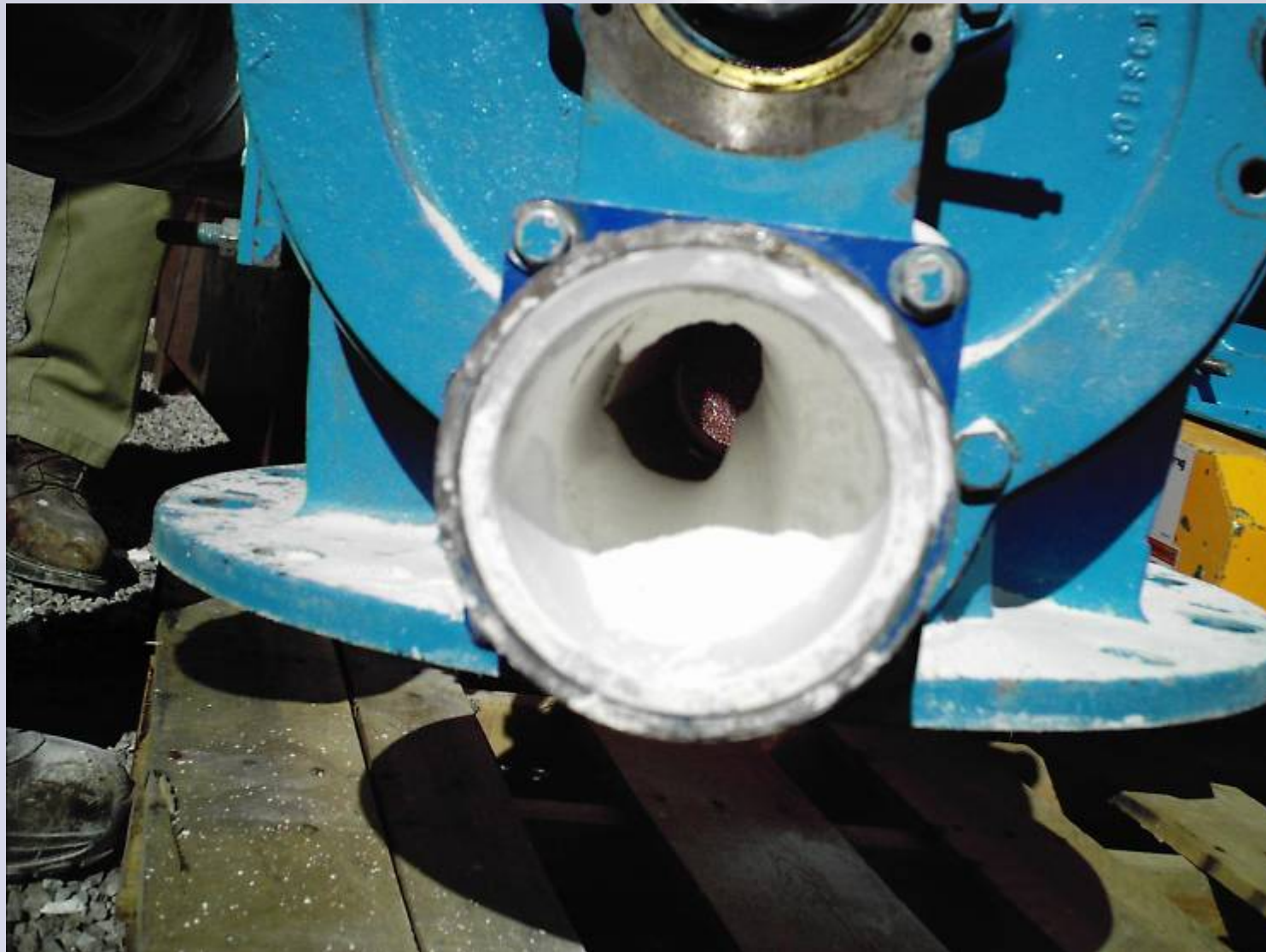
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Plugging and Material Buildup



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Rotary Airlock Outlet



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Plugging and Material Buildup



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Lance Tip Buildup



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Lance Buildup & Corrosion



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Lance Corrosion



Operating Experiences & Lessons Learned

- Plugging & Material Build-Up – Causes
 - Moisture
 - Temperature (Heat)
 - Transport Velocity – Impaction
 - Convey Air CO₂
 - Improper Pipeline Installation

Operating Experiences & Lessons Learned

- Plugging & Material Build-Up – Solutions
 - Convey Air Dehumidification (selective)
 - Convey Air Heat Exchanger
 - Offload Screen Orifice size
 - Lance Diameter (>1&1/4 inch)
 - T-Bends or Rubber Hose Bends
 - Long Radius Bends
 - Air Purge System (selective)
 - CO₂ Removal
 - Alternative Lance Designs
 - Buildup Monitoring & Detection – Pressure Differential

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Chiller



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Dryer/Dehumidifier



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Heat Exchanger



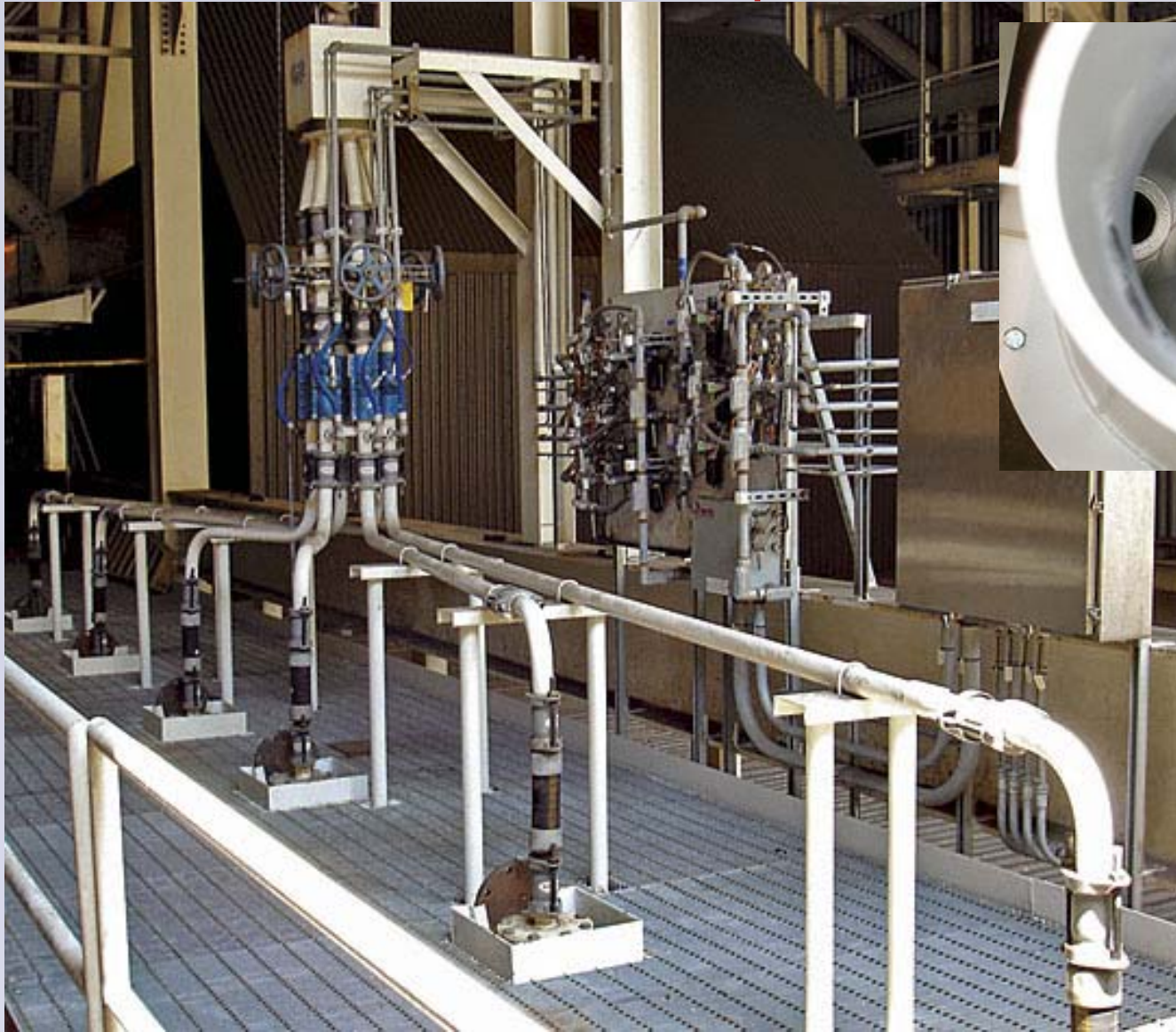
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Convey Lines



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Splitters



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Splitter Assembly



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Injection Point – Lance Purge



Operating Experiences & Lessons Learned

- Abrasiveness & Wear – Trouble Spots
 - Elbows & Bends
 - Erosion to Failure
 - Rotary Airlocks
 - Improper Purging & Packing Materials
 - Lances
 - Plugging
 - Wear/Fatigue/Breakage

Operating Experiences & Lessons Learned

- Abrasiveness & Wear – Causes
 - Sorbent (variable grades or supplies)
 - Transport Velocity
 - Component Materials of Construction
 - Excessive Pipeline Bends

Operating Experiences & Lessons Learned

■ Abrasiveness & Wear – Solutions

- Testing of Specific Sorbent(s) and Grade(s) to be used
- Ni-Hard Long Radius Bends or Hose Bends
- T-Bends
- Control excessive transport velocities
- Alternative Lance Designs
- Reduce # of Pipeline Bends

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Abrasiveness and Wear



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Abrasiveness and Wear



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Convey Lines



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Truck Fill Line & Dust Collection



Operating Experiences & Lessons Learned

- “Flow-ability” – Trouble Spots
 - Rail & Truck Unload
 - Storage Silo
 - Very Long Pipe Runs

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Truck/Rail Unload



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Storage Silos



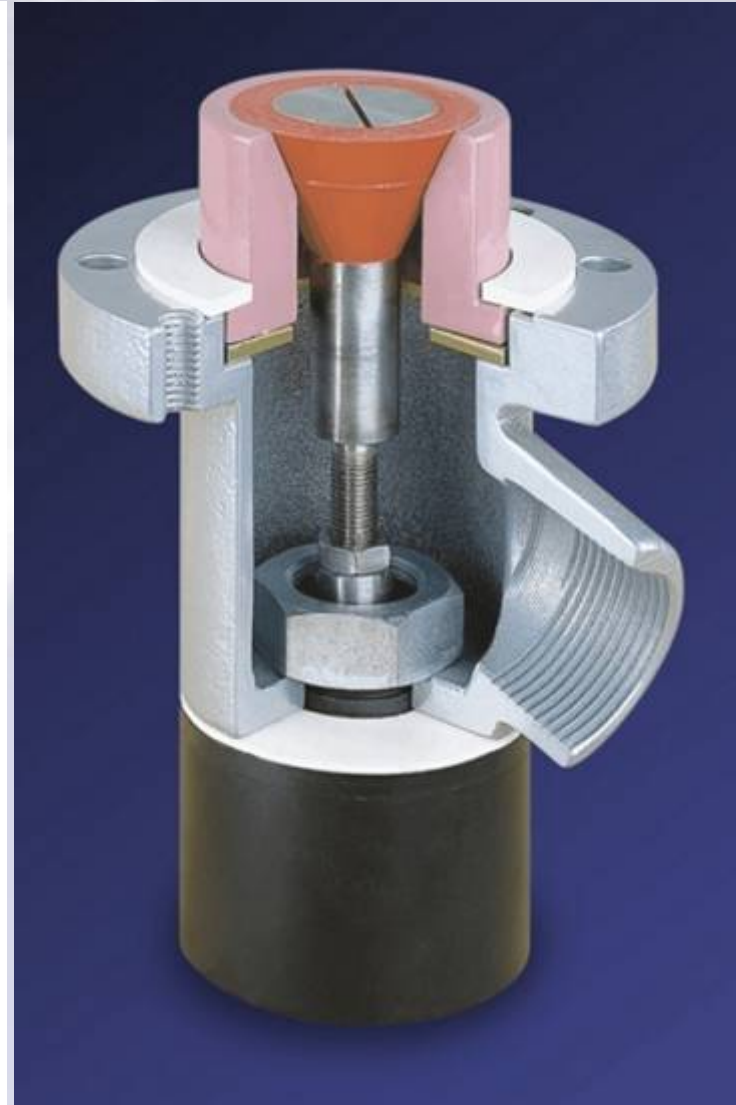
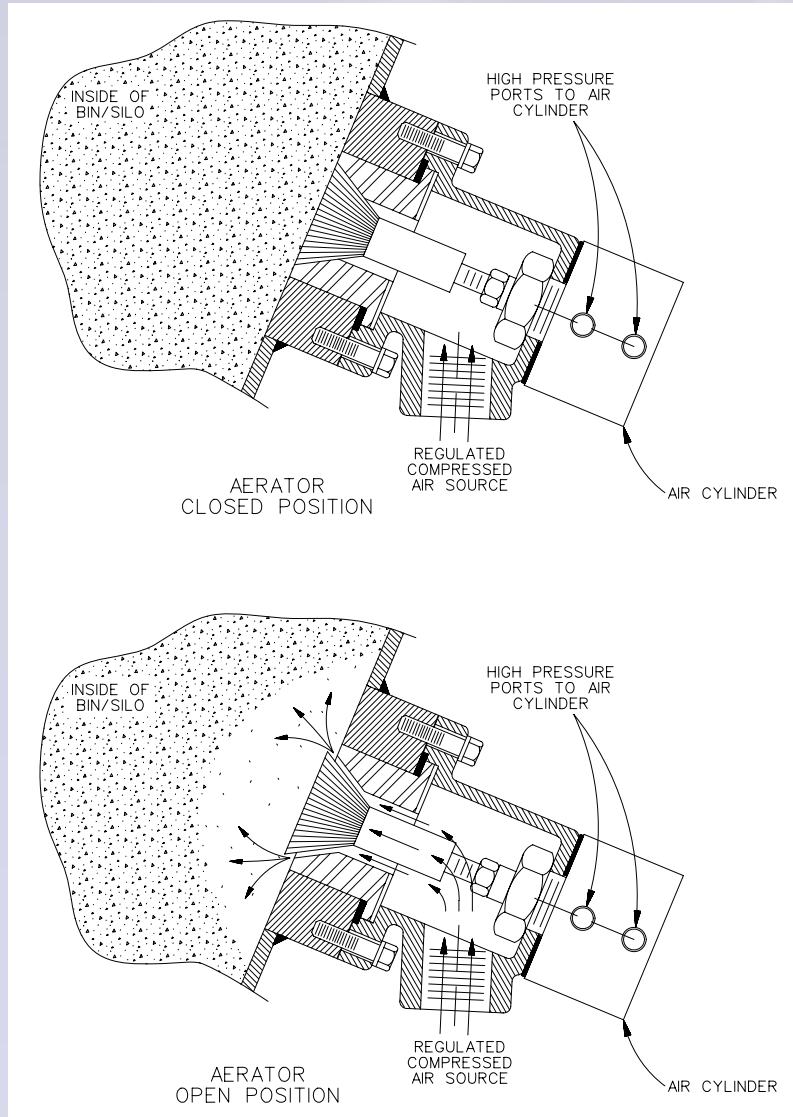
Operating Experiences & Lessons Learned

- “Flow-ability” Issues – Causes
 - Moisture
 - Long Transport Distances
 - Compaction/Agglomeration (particle size)
 - Temperature (Heat)
 - CO₂ in Transport Air

Operating Experiences & Lessons Learned

- “Flow-ability” Issues – Solutions
 - Convey Air Dehumidification (selective)
 - Convey Air Heat Exchanger
 - Silo Discharge Aeration
 - Particle Size Control – Storage
 - In Line Milling
 - Dense Phase Pneumatic Conveying
 - CO₂ Removal - Transport Air

Silo Aeration/Discharge



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Silo Discharge Aeration



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Silo Discharge
Aeration video



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Portable Mill



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Air Assist



Operating Experiences & Lessons Learned

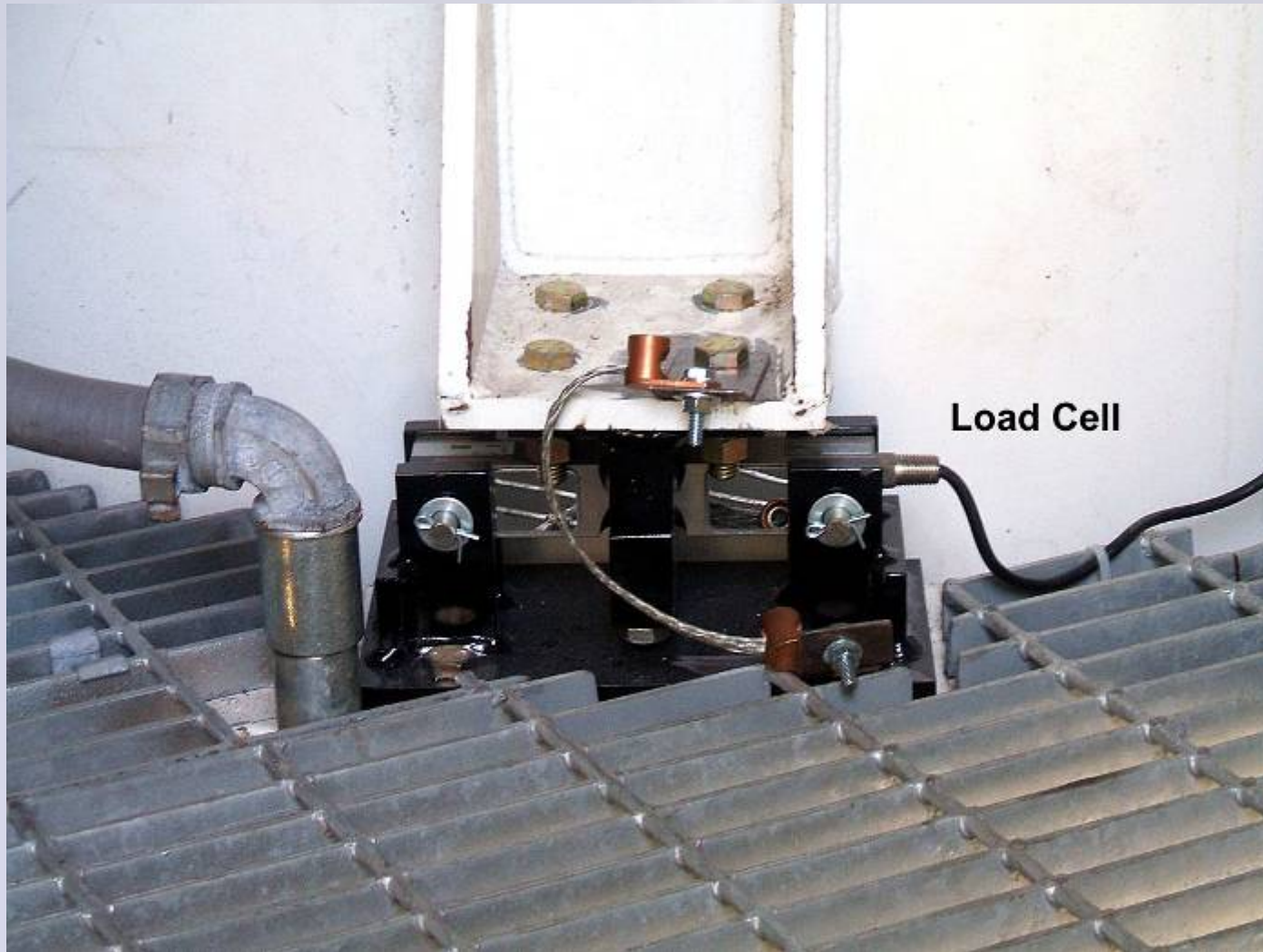
- Controlled/Consistent Feed Rate – Trouble Spots
 - Manage Sorbent Usage
 - Consistent Reliable Feed Rate
 - Cover Wide Range of Conditions
 - Flexibility to Change Sorbent Type

Operating Experiences & Lessons Learned

- Controlled/Consistent Feed Rate – Solutions
 - Automated Loss-In-Weight Measurement
 - Variable Speed Rotary Airlocks
 - Turndown Ratio Design
 - Silo Discharge Aeration
 - Measurement – Pressure Differential

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Load Cell



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Silo Discharge



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L-I-W Feeders

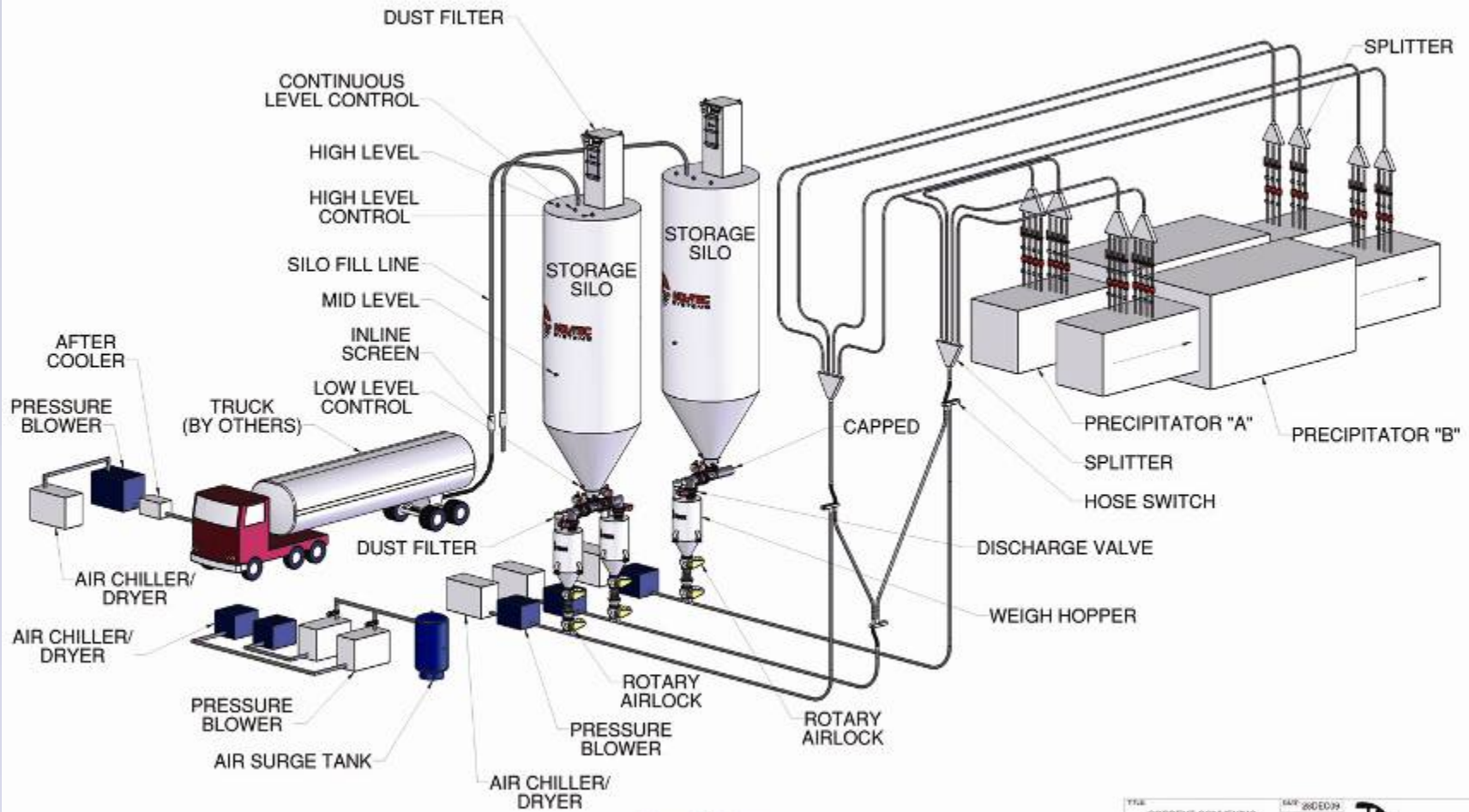


System Design Considerations

- Overall Considerations
 - Robust system components – durability
 - Flexible for alternative sorbents
 - Capability for broad range of feed rates and maximum feed rate “factor of safety”
 - Reliability through key component redundancy
 - Flexibility for alternative points of sorbent injection

“Good” Design Practices

- 99+ % Run uptime
- Flexibility for variable feed rates: 1 to 5 range
- Capacity 10% to 20 % above maximum design rate
- Integrated control system meeting customer needs
- High accuracy splitter design
- Redundancy and crossover design for reliability



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Technology

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Clean Air Solutions

utilizing

SORB-N-JECT™
Technology

SO₂, SO₃, Hg, HCl, HF



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