

REINHOLD ENVIRONMENTAL Ltd.



## **2016 APC-Wastewater Round Table & Expo Presentation**

July 18 & 19, 2016 in Dearborn, MI / Hosted by DTE Energy

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# Detuning Upstream ESPs for MATs Operation

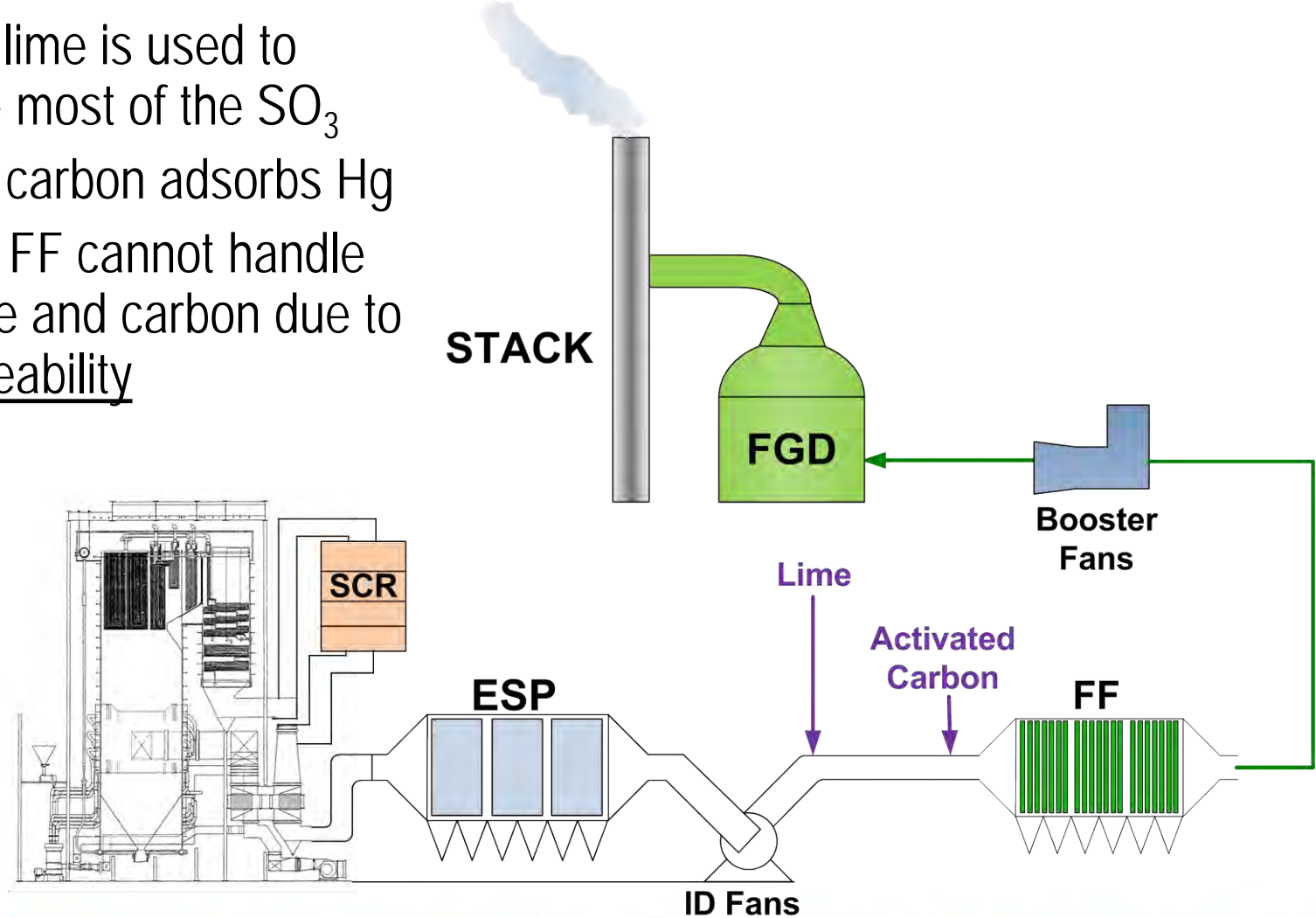
## Southern Company Strategy

2016 APC-Wastewater Round Table  
July 18-19, 2016

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# MATS Strategy Involving Baghouses

- Hydrated lime is used to neutralize most of the  $\text{SO}_3$
- Activated carbon adsorbs Hg
- However, FF cannot handle 100% lime and carbon due to low permeability

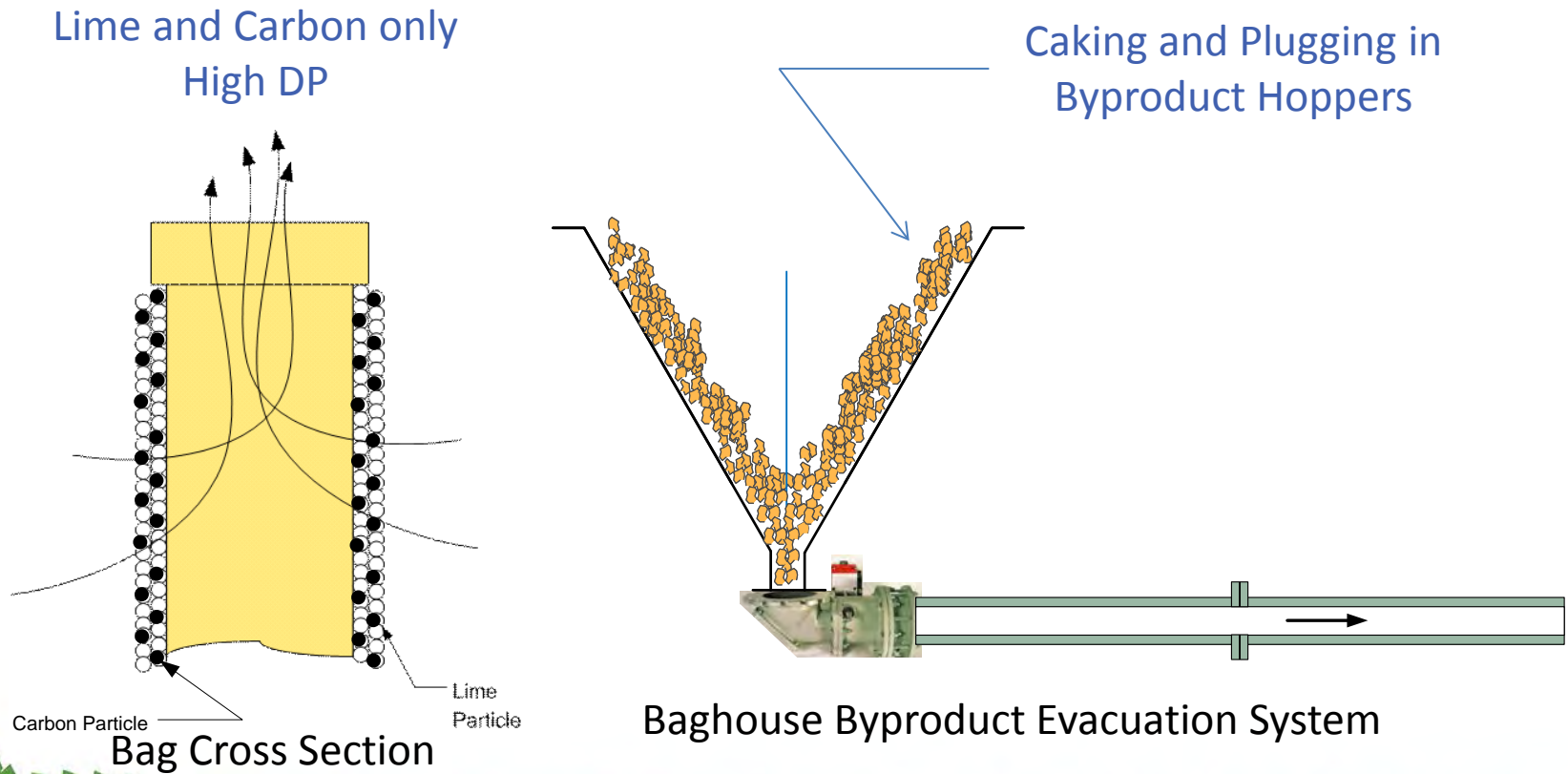


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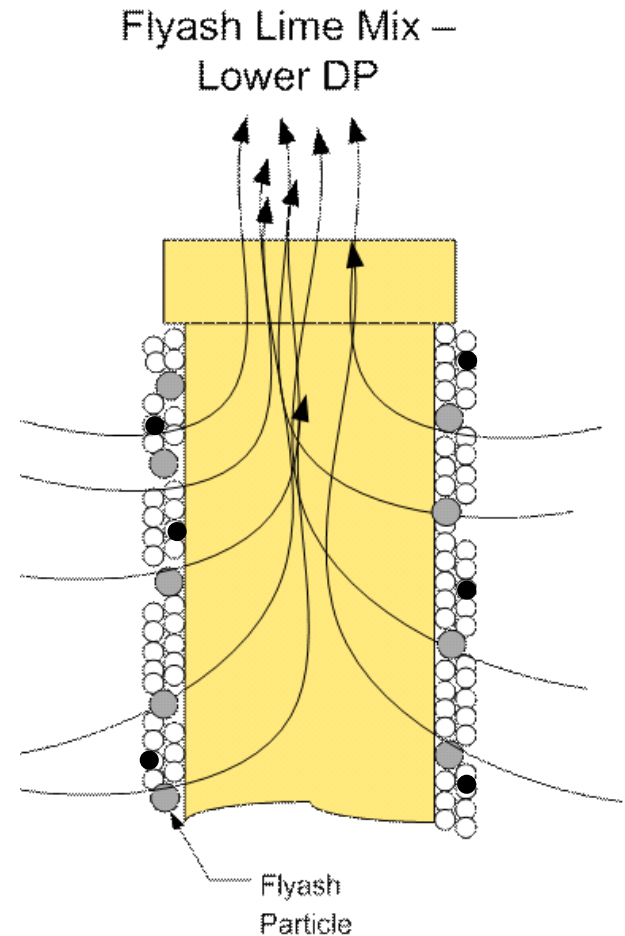
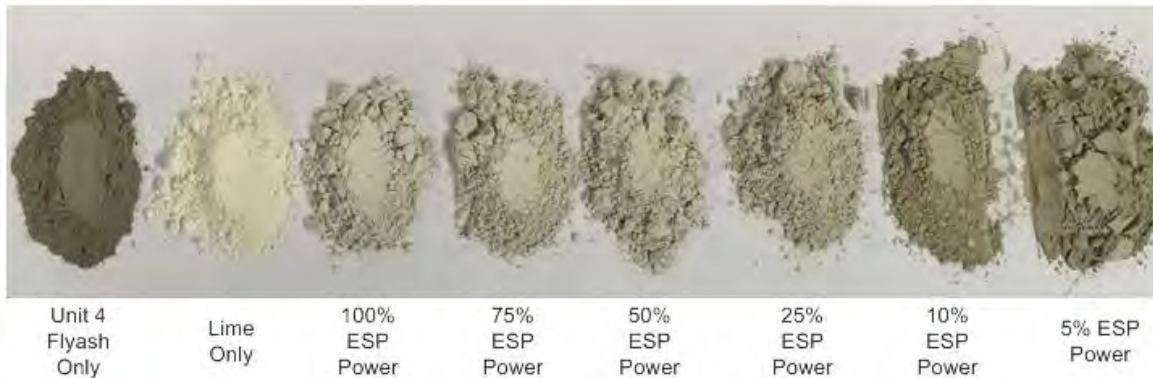
# Bag Permeability

- 100% Lime and carbon blinds bags
- It also causes flowability problems in the evacuation system



# Bag Permeability (Cont.)

- Goals of ESP Detuning
  - Produce sufficient flyash in the mix to control DP
    - Target 1:1 to 2:1 Ratio
  - Best Hg capture at the lowest lime and carbon addition



# Solution

- Allow more flyash to slip by ESP by detuning
- Detuning means reducing corona power to the ESP fields

## Electrode Corona



## Deutsch Anderson ESP Efficiency Equation

$$EFF = 1 - e^{-\frac{A}{V}w}$$

$$W = \frac{E_o E_p a}{2 \pi \eta}$$

EFF = Fractional % Collected

A = Surface Area Collecting Electrodes

V = Volumetric Flow Rate

w = Particle Drift Velocity or Rate Parameter

E<sub>o</sub> = Charging Fields  $\frac{\text{Volts}}{\text{Distance}}$

E<sub>p</sub> = Collecting Field  $\frac{\text{Volts}}{\text{Distance}}$

a = Particle Radius

η = Gas Viscosity

π = 3.1416

Courtesy: J. Knapik

# Objectives of ESP Detuning

- Allow more flyash to slip by the ESP, But...
  - Selectively slip largest particle sizes
  - Don't wear out the fans
  - Keep it stable
  - Don't overload the baghouse

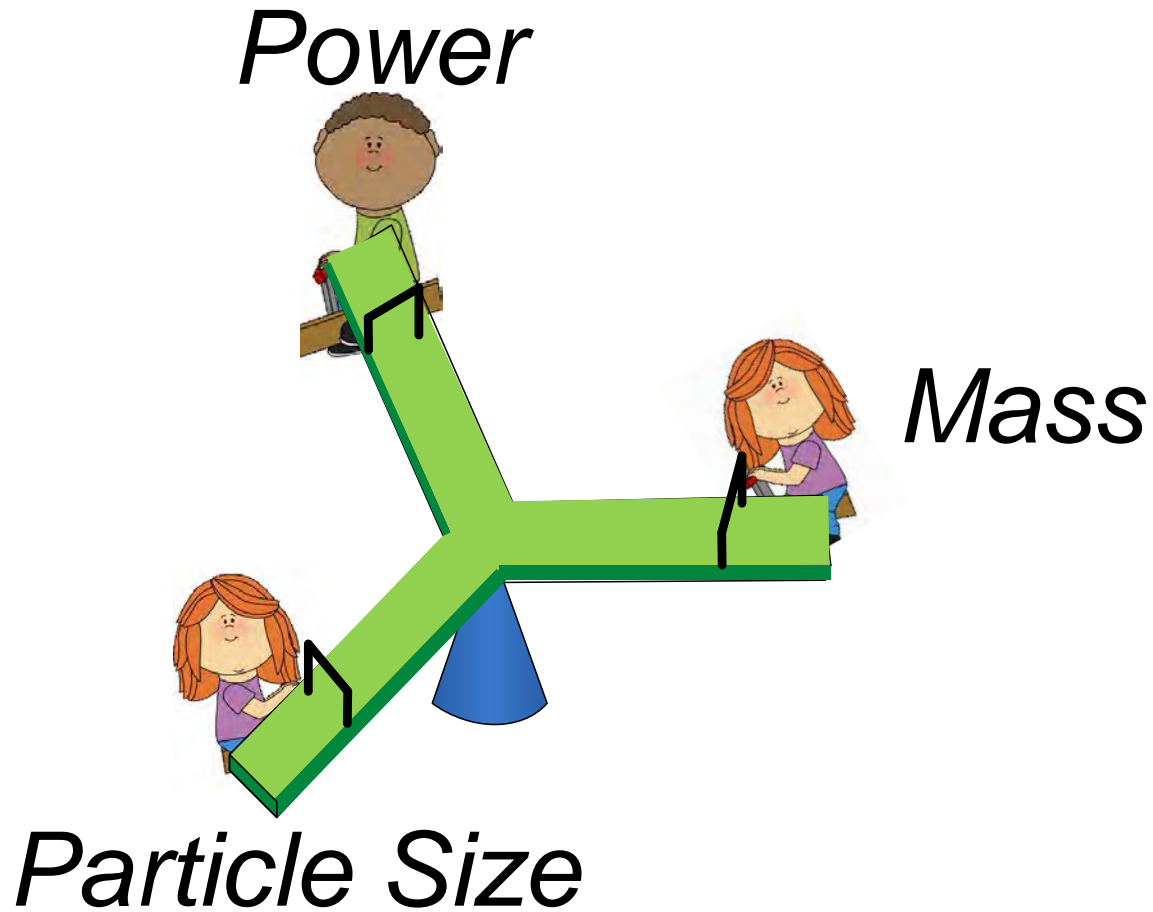


Axial Fan Components- High Risk



Centrifugal Fan Components- Medium Risk

# Balance of Objectives



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# Particle Size Measurement Methods

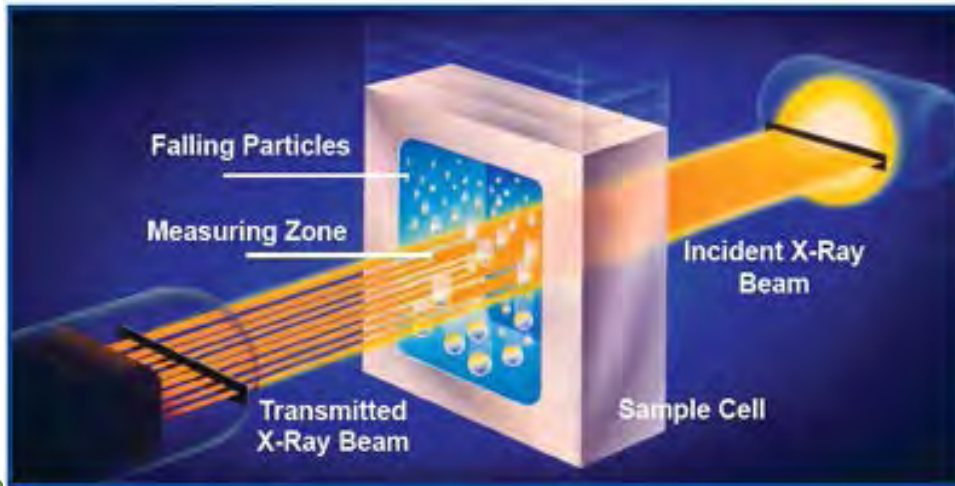
- Cascade Impactor
  - In-situ sampling, laboratory analysis
  - Highly accurate
  - May require long sampling time
  - Isokinetic



Andersen/Thermo

# Particle Size Measurement Methods (Cont.)

- Sedimentology
  - Laboratory analysis
  - Highly accurate
  - Long turnaround
  - Must collect isokinetic sample first



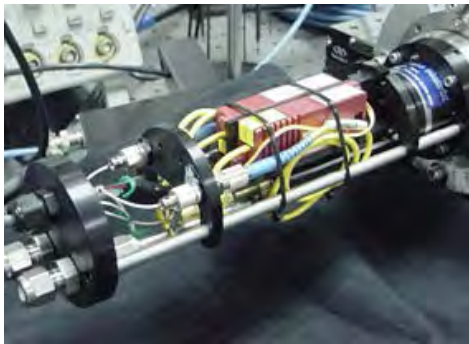
Micromeritics Corp.

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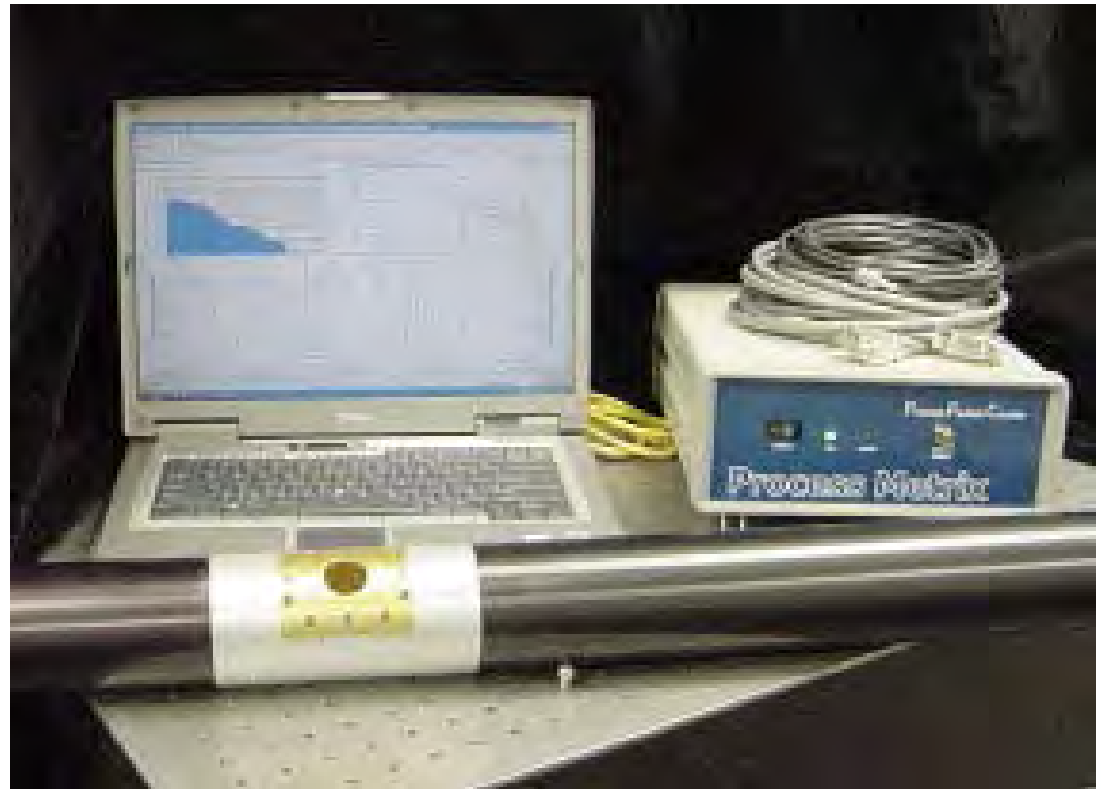
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# Particle Size Measurement Methods (Cont.)

- Laser-Optical Counter/Sizer
  - Gives size distribution, particle velocity and mass
  - In-situ sampling
  - Highly accurate
  - Requires skilled operator
  - Complex setup



Process Metrix LLC



# Particle Size Measurement Methods (Cont.)

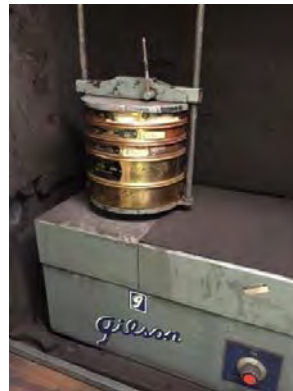
- High Volume Sampling / Sieving
  - In-situ / Laboratory
  - Semi - Isokinetic
  - Medium accuracy, but repeatable
  - Short turnaround
  - Medium skill levels required



Storm Technologies Probe



Recovery



Shaking



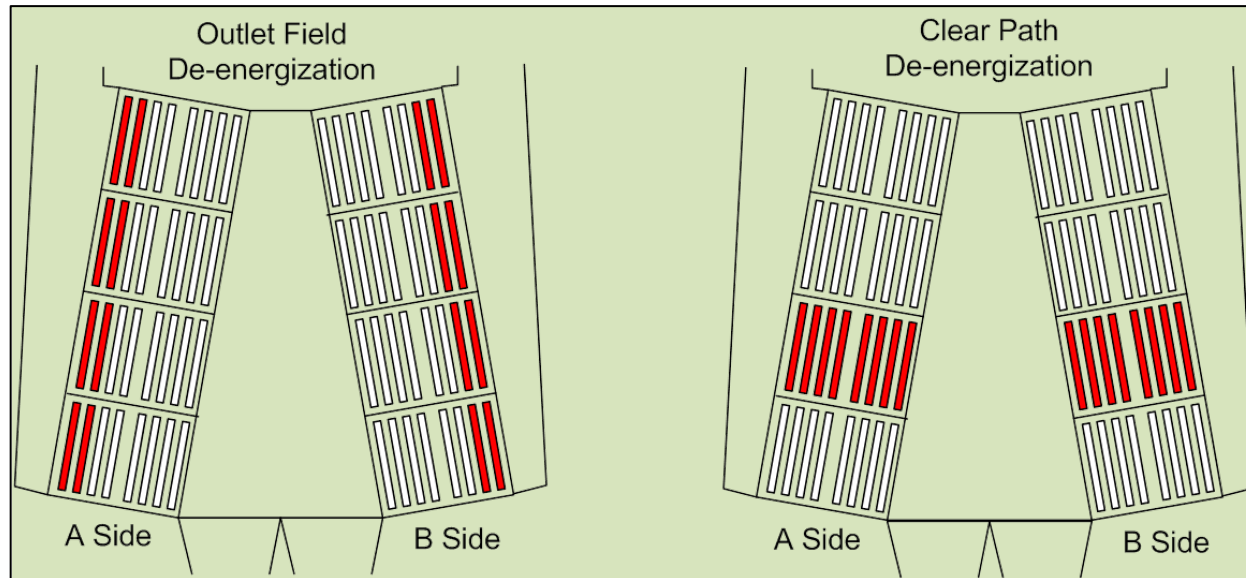
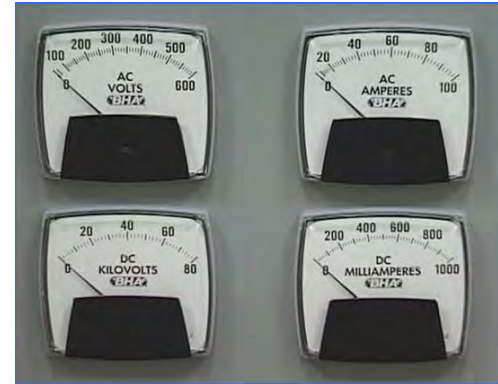
Sieving



Weighing

# Detuning Methods

- Three Methods Tested:
  - Overall power reduction
  - Parallel fields out of service
  - Series fields out of service



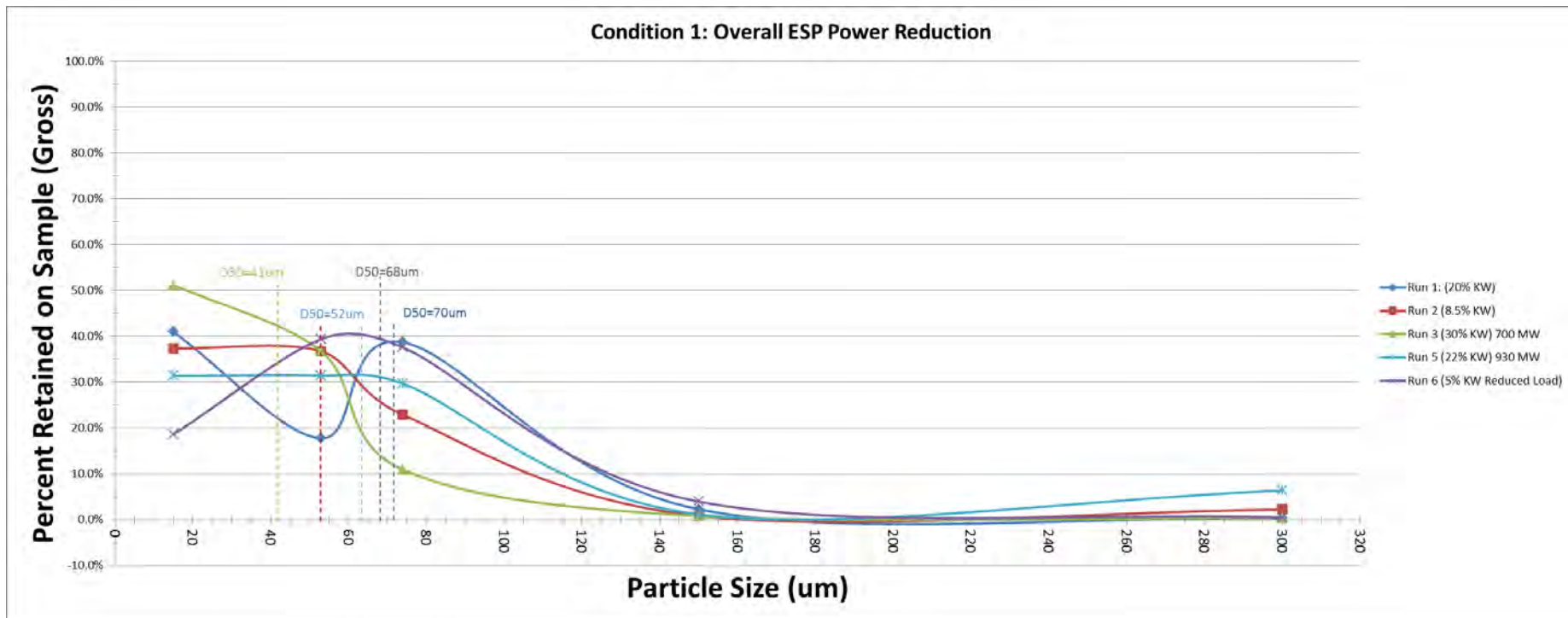
# Case 1 Results

- Layout
  - Electrodes RDEs on 11"
  - SCA @ 9" 259
  - Gas Velocity 5.02 ft/sec
  - Fuel Illinois Basin 2.5% Sulfur
  - Casing Configuration Cold Side, Chevron
  - Powering T-Rs



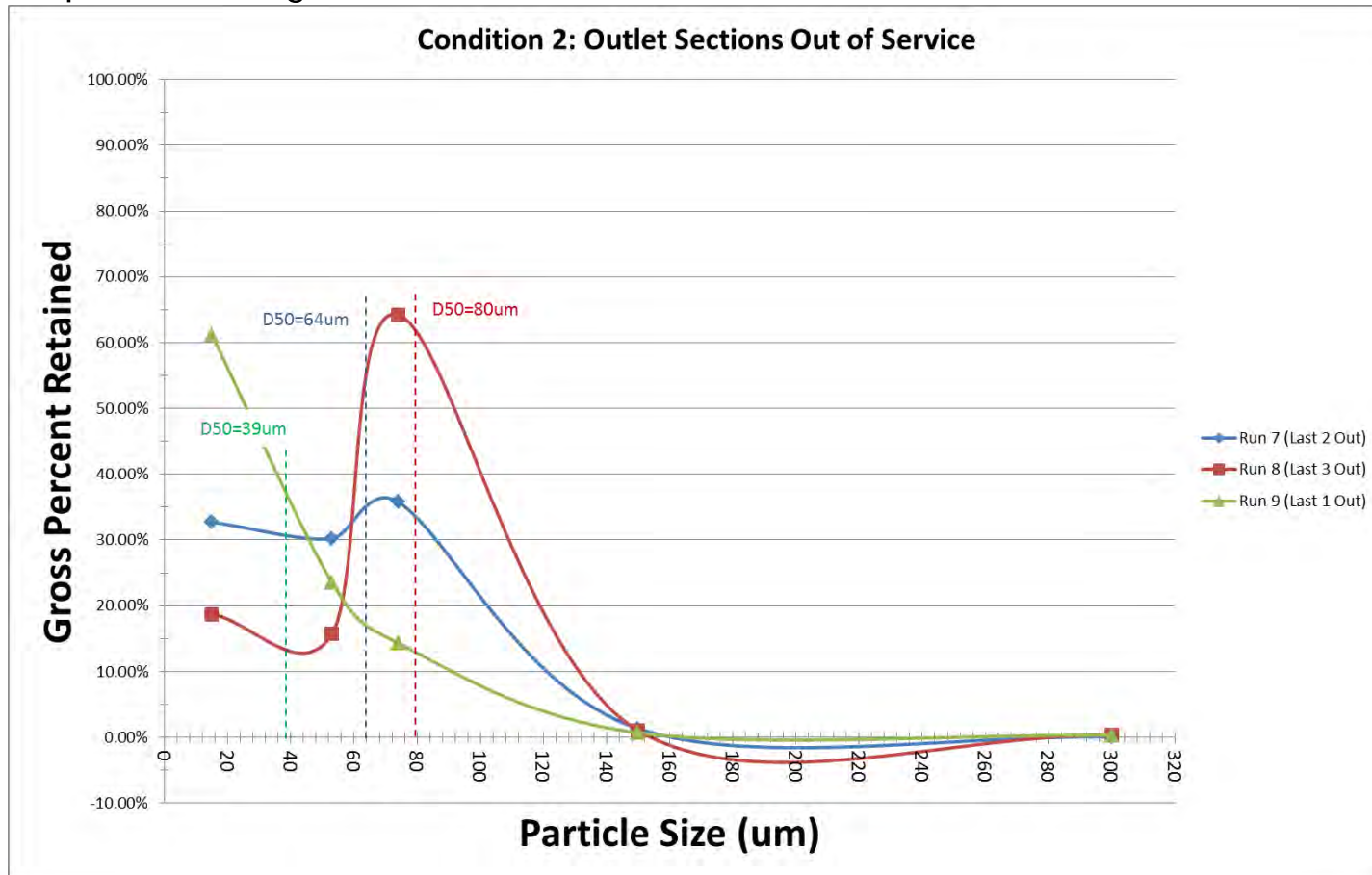
# Case 1 Results: Overall Reduction

- Mass Median Diameter
  - Produced the smallest mass median particle diameter (41-70um)
  - Required the greatest level of power reduction to reach target ash/lime ratio



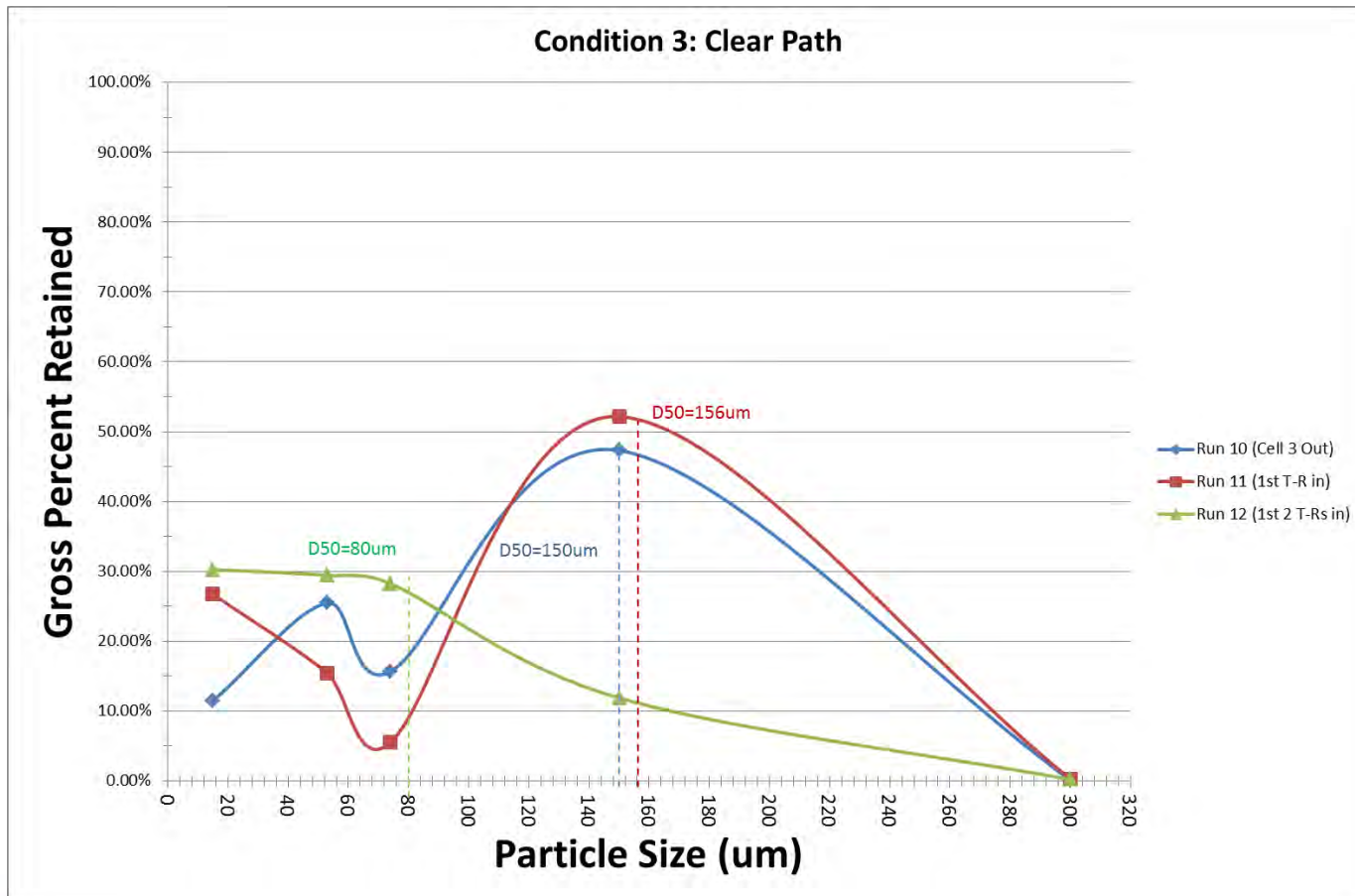
# Case 1 Results: Parallel Sections Out of Service

- Mass Median Diameter
  - Produced average mass median particle diameter (39-80um)
  - Required average level reduction of the three methods tested

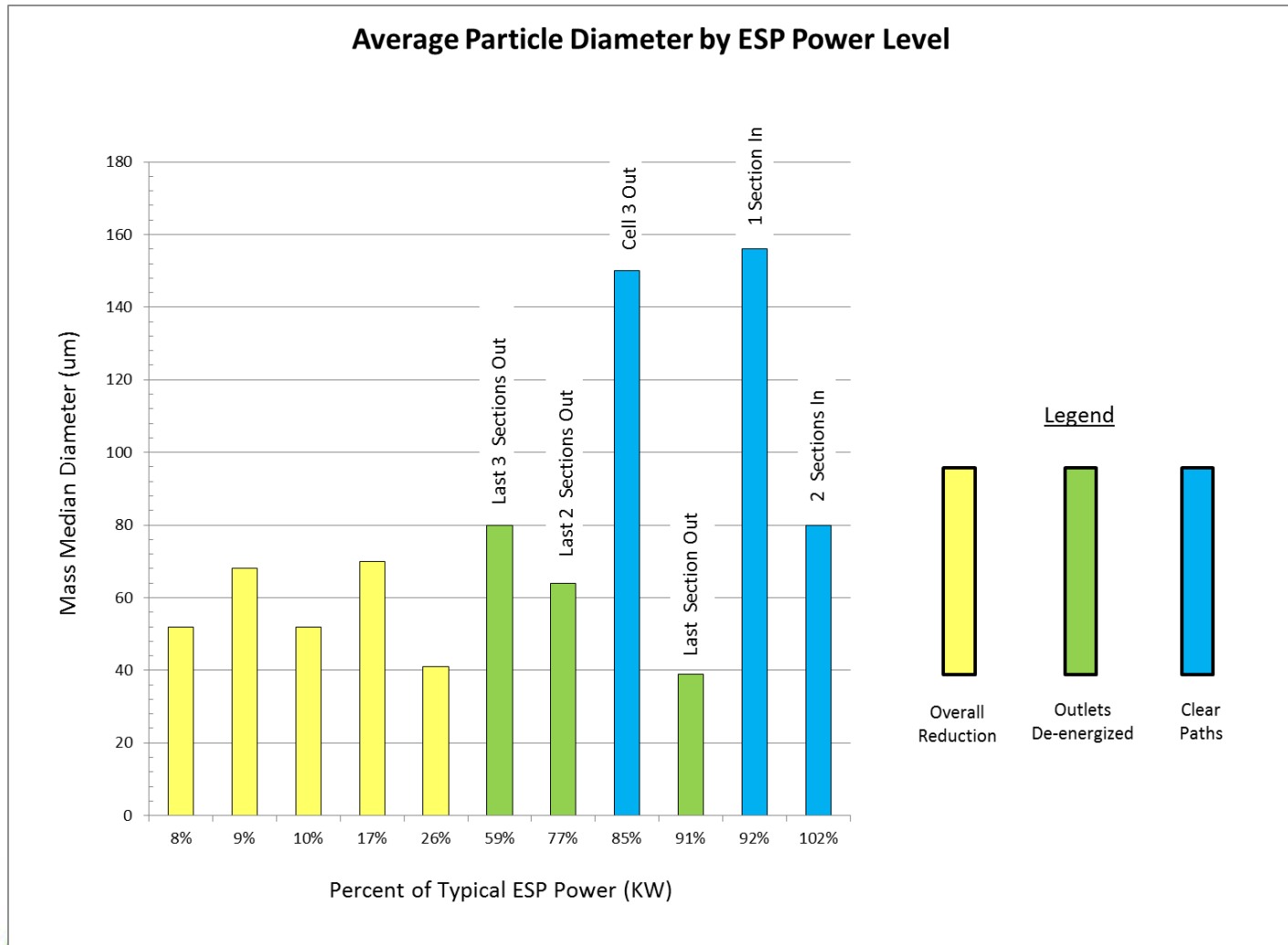


# Case 1 Results: Series Sections out of Service

- Mass Median Diameter
  - Produced largest mass median particle diameter (80-156um)
  - Required lowest level reduction of the three methods tested



# Case 1 Results: ESP Power vs. Particle Size



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# Case 2 Results

- Case 2 Hotside ESP Layout

- Electrodes RDEs on 12"
- SCA @ 9" 286
- Gas Velocity 4.7 ft/sec
- Fuel Ala Med Sodium
- Casing Configuration Hot Side
- Powering SMPs

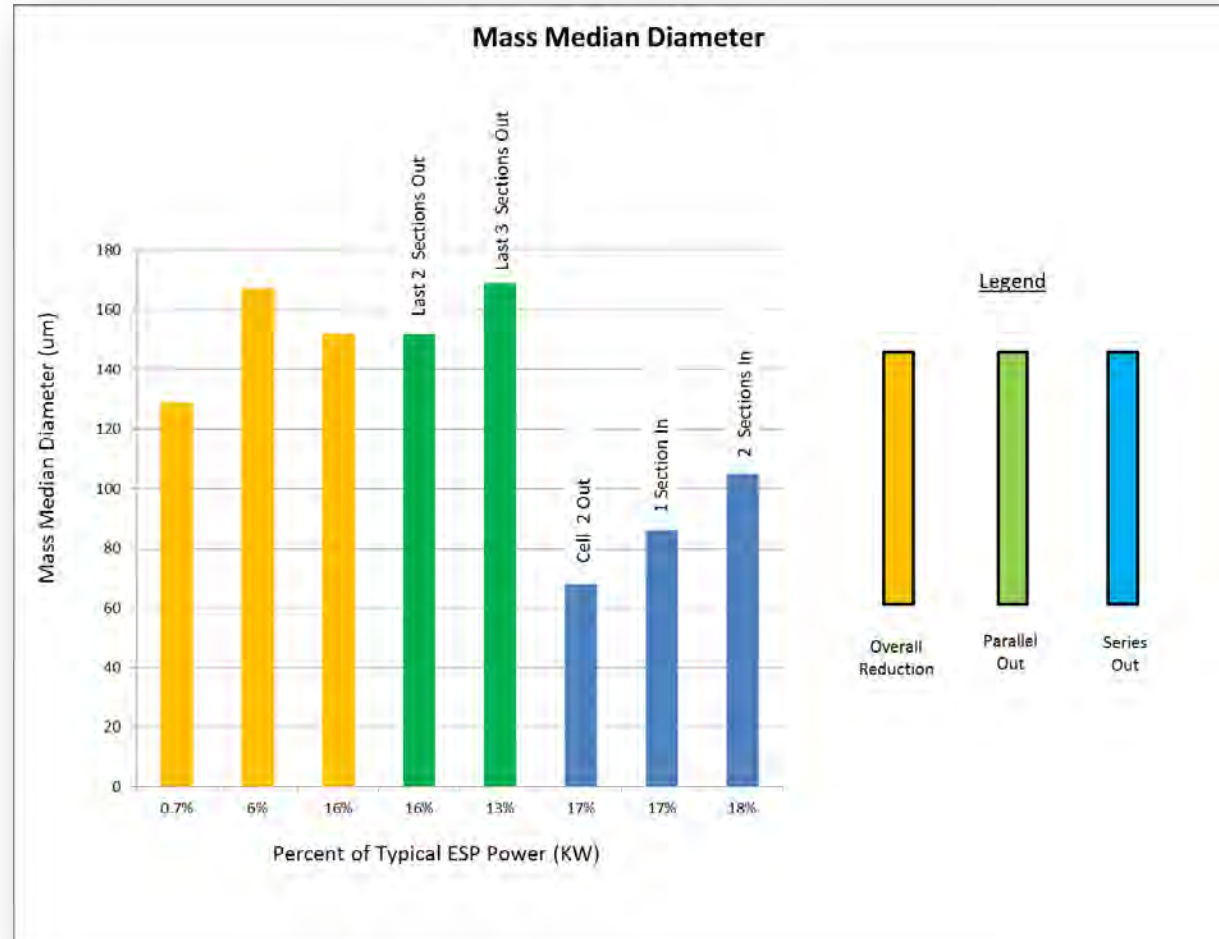
- Case 2 Coldsid ESP Layout

- Electrodes RDEs on 11"
- SCA @ 9" 259
- Gas Velocity 6.18 ft/sec
- Fuel Ala Med Sulfur
- Casing Configuration Cold Side, Chevron
- Powering T-Rs



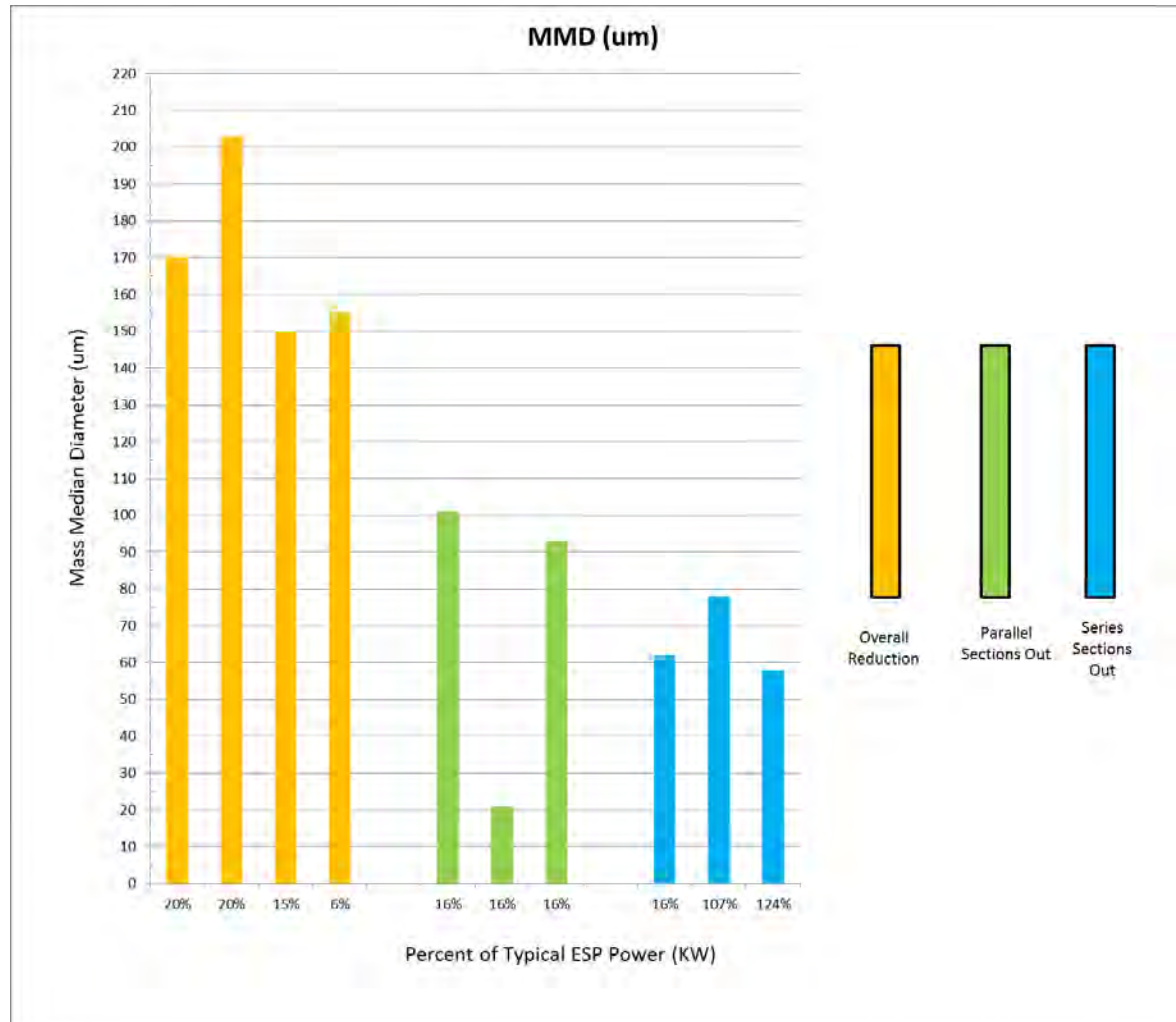
# Case 2 Hotside Results

- Mass Median Diameter
  - Shows greatest MMD to be from Parallel reduction (152-169)
  - Second largest from Overall Power Reduction (132-167um).
  - Series Sections out of Service only provided a 68-107um size.



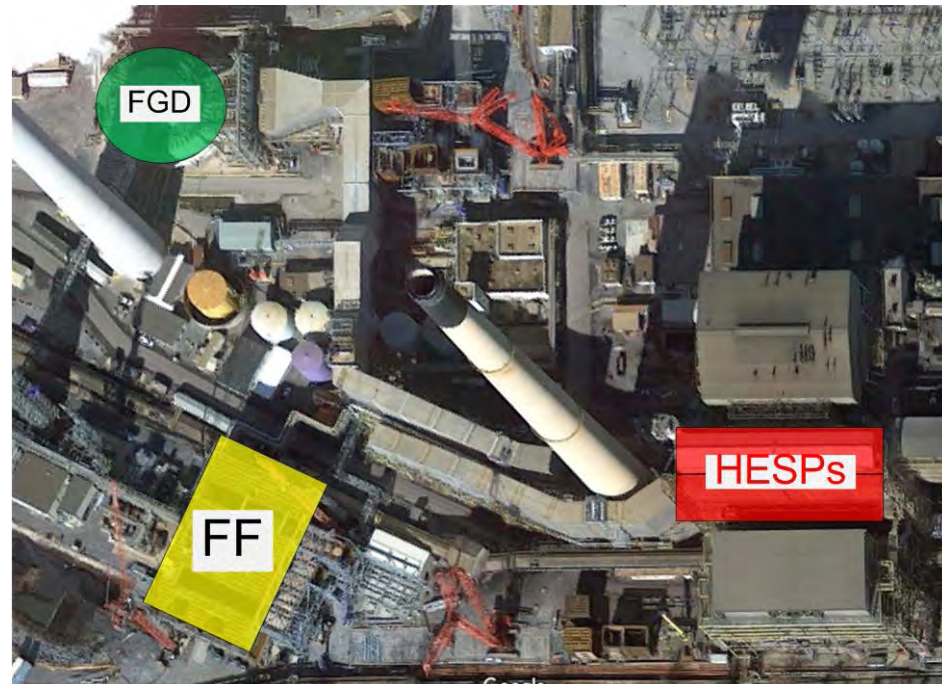
# Case 2 Coldsides Results

- Mass Median Diameter
  - Shows greatest MMD to be from Overall Power Reduction (150-170um).
  - Second largest from runs 7&9 of Parallel Sections out of Service (93-101)
  - Third largest from Series Sections out of service (58-78)



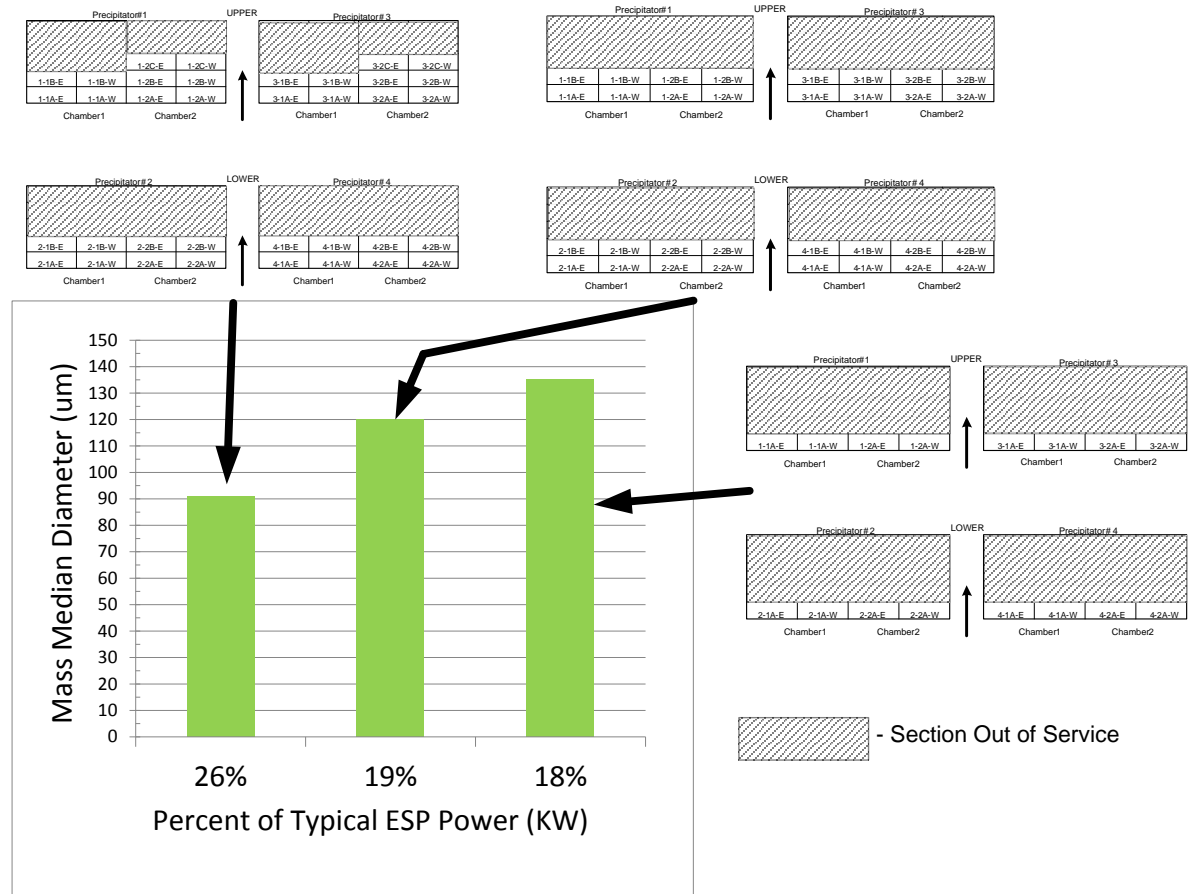
# Case 3 Results

- Layout
  - Electrodes RDEs on 12"
  - SCA @ 9" 271
  - Gas Velocity 4.92 ft/sec
  - Fuel Ala Med Sodium
  - Casing Configuration Hot Side, Piggybacked
  - Powering T-Rs



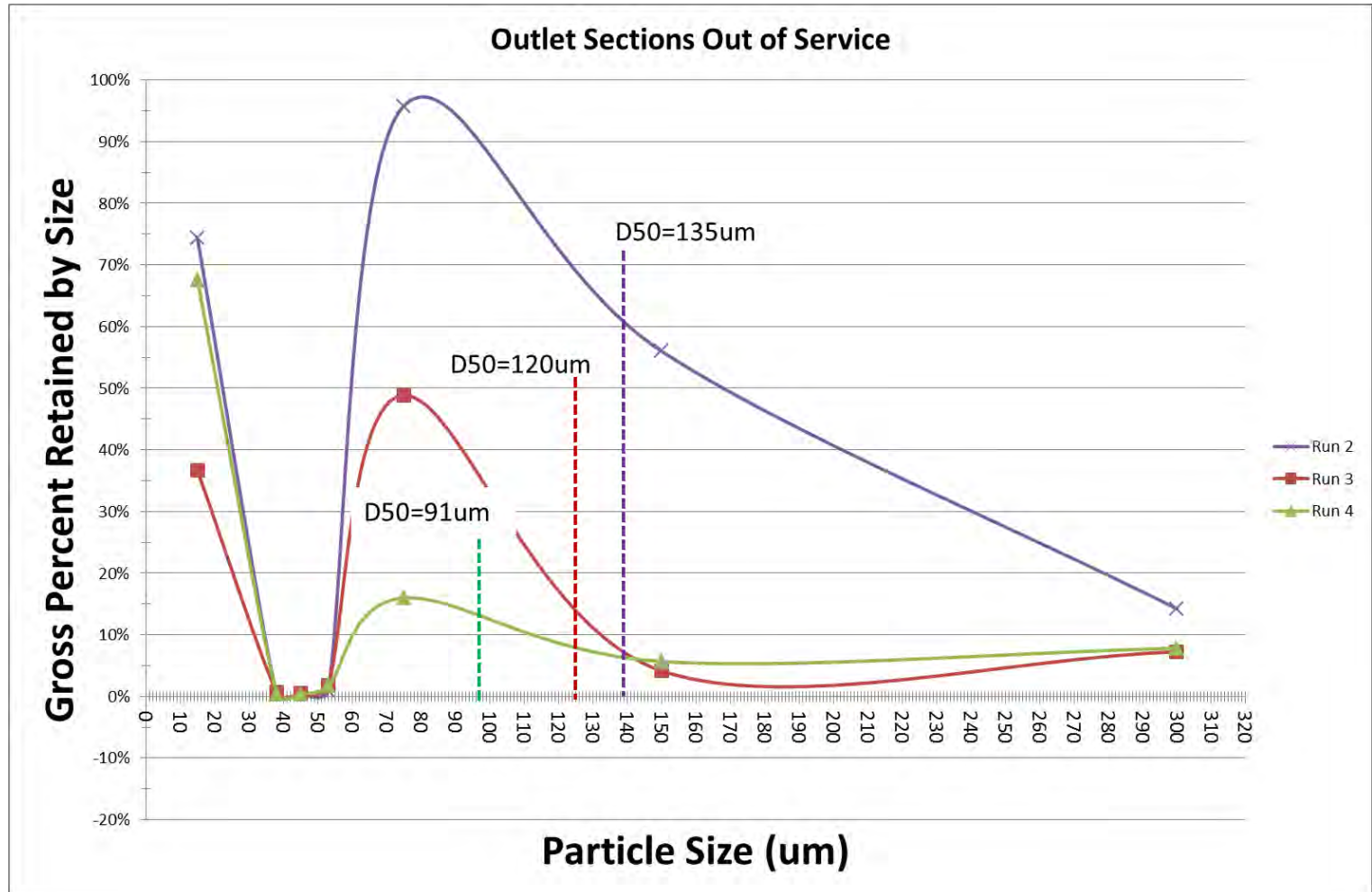
# Case 3 Hotside Results

- Mass Median Diameter
  - Only Parallel Sections out of Service tested
  - Shows MMD range to be from (91-135)



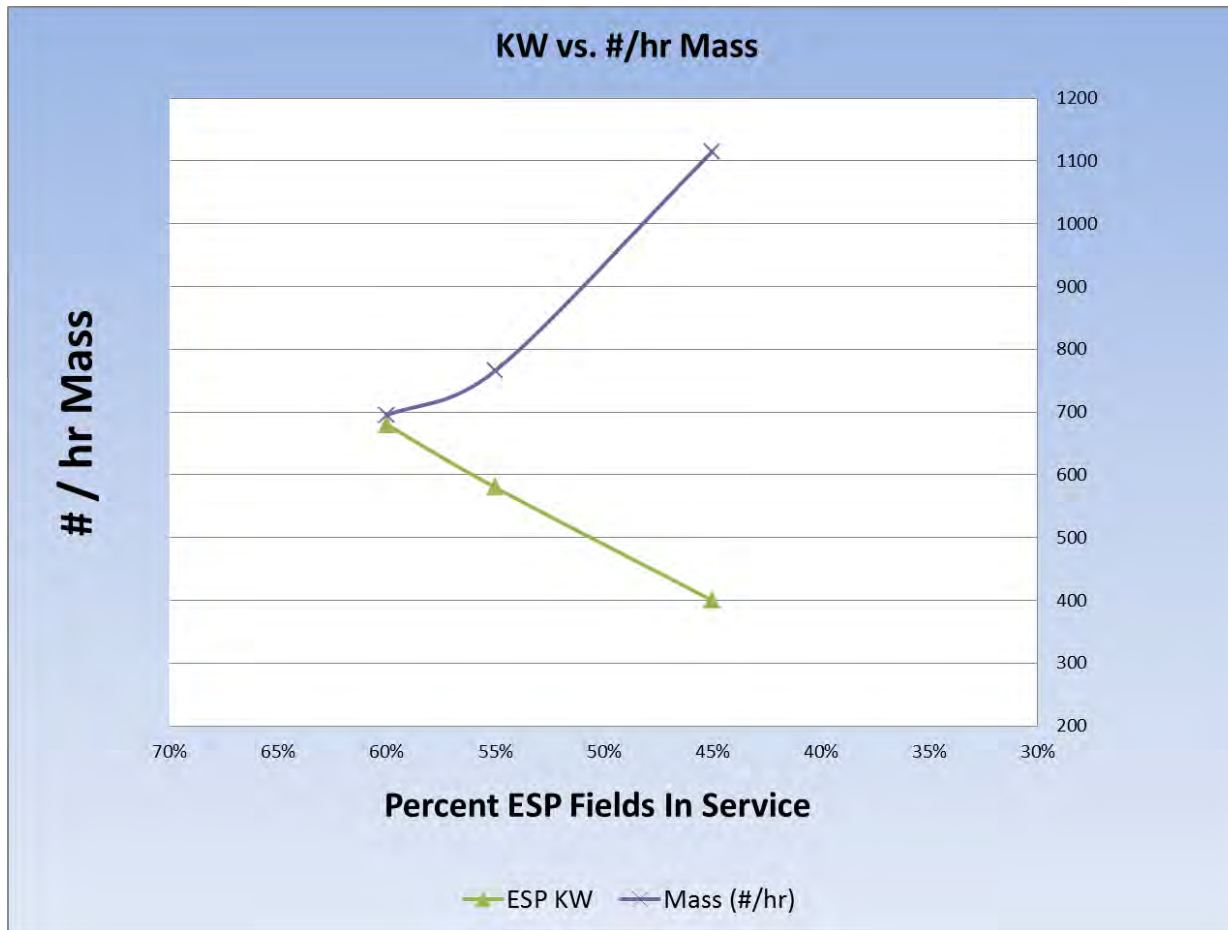
# Case 3 Hotside Results

- Curves for Case 3



# Case 3 Hotside Results

- Sections in service vs. Mass



# Conclusions

- No one approach worked the best in all cases.
- Not all plants opted to operate in the mode that produced the largest particle size. They differed due to: 1) Regulatory limitations, 2) Concerns over fan erosion, 3) Opacity instability, 4) Convenience.
- Overall Power Reduction, in general, caused the greatest mass (Opacity) instability.
- Time did not allow for DP comparisons, but many runs indicated DP reductions as a result of mode changes.
- Some mass emissions creep has been experienced and therefore, a series of tests over time is recommended.

# Summary

- The table below shows the power reduction condition that produced the best (greatest) mass median particle size. It also shows what approach was adopted by the particular plant.

Test	Best Findings			Adopted Approach		
	Overall Reduction	Parallel Sections out of Service	Series Sections Out of Service	Overall Reduction	Parallel Sections out of Service	Series Sections Out of Service
Case 1			X		X	
Case 2 Hot		X		X		
Case 2 Cold	X			X		
Case 3		X			X	

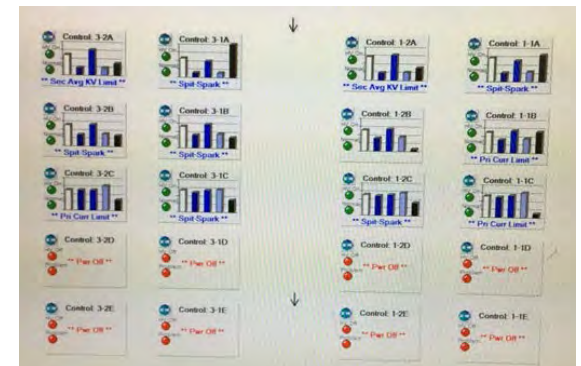
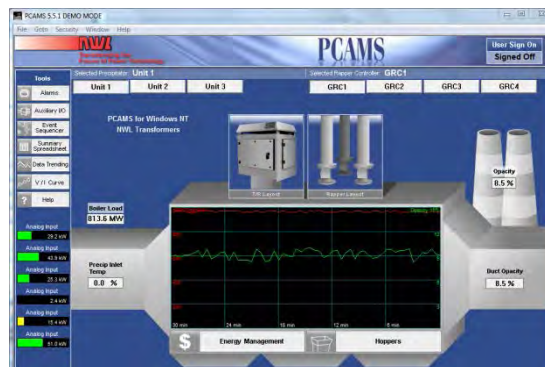
# Summary (Cont.)

- Pros and Cons of each Approach

Approach	Pros	Cons
Overall Reduction	- Highest control resolution	- Requires greatest amount of reduction to obtain same mass - Becomes unstable at low power levels
Parallel Sections out of Service	- Cuts across gas flow and all conditions	- Limited to quantity of fields available - Limited control resolution
Series Sections out of Service	- Concentrates adjustments to smallest area	- Can result in complete clear path - Can threaten downstream fans

# Future Program

- Automate the detuning process
  - Working with control manufactures to modify their data management systems to accept a baghouse in service and out of service command
- Periodically check baghouse byproduct composition
  - Can be done though elemental analysis or density
- Monitor byproduct handling performance
  - Sticky valves
  - Plugged hoppers



# Thank You - Questions?



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