

REINHOLD ENVIRONMENTAL Ltd.



2011 APC Round Table & Expo Presentation

July 11-12, 2011, in Cleveland, OH / Hosted by FirstEnergy

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Aging ESPs – How To Improve Performance

PCUG Round Table- Cleveland Ohio
July 11, 2011

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Southern Company
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Why Do We Need to Improve Performance?

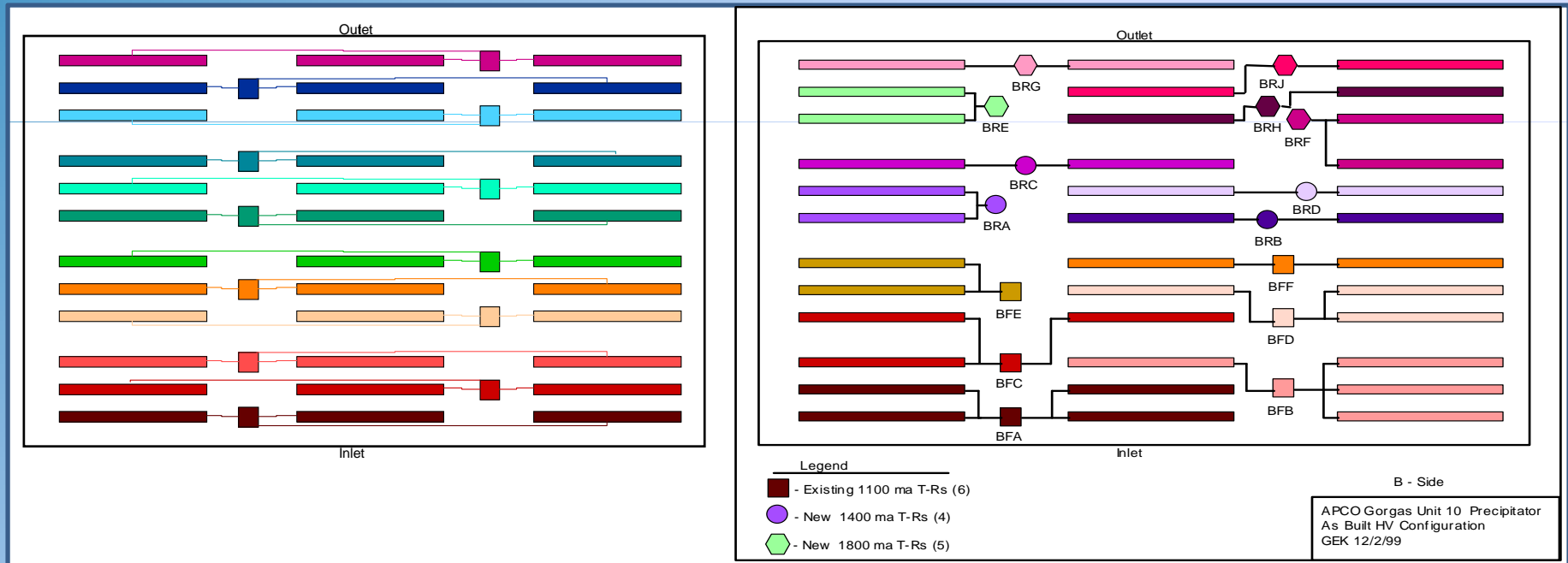
- To Restore Performance Degradation Due to:
 - Fuel Changes
 - Aging Effects: Corrosion, Misalignment, Ineffective rapping, Inoperative Auxiliary Equipment
- Visibility Issues (Required to perform better than permit requirements)
- EGU MACT (Preliminary)
 - 0.03 lb/MBtu Total, 30 day average with PM CEMS, No exceptions for start up, shut down or malfunction

What are the Options for Improvement?

- Power Sectionalization
- Rapping Sectionalization
- Repowering
- Rebuilding / Converting
- Flow Improvement
- Gas Conditioning
- Collecting Area Expansion

Power Sectionalization

- Splitting Bus Sections
- Adding T-Rs

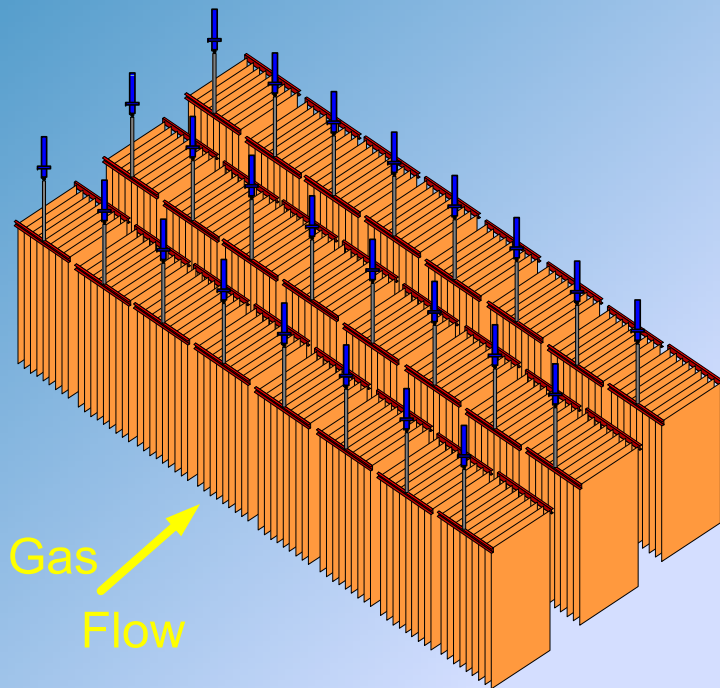


Original Sectionalization

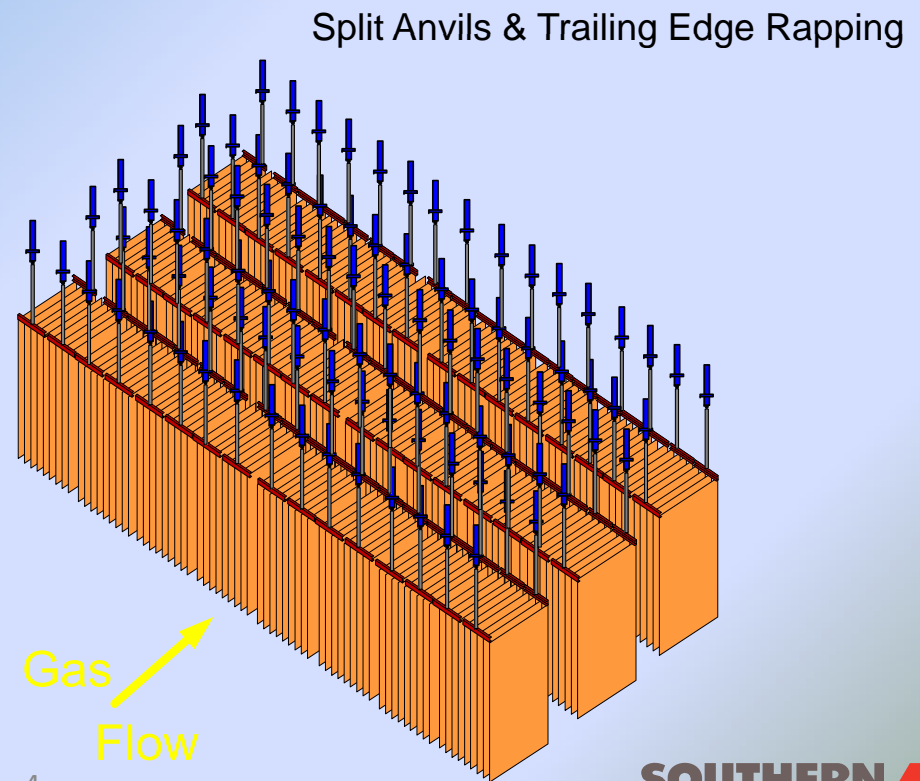
After Re-sectionaling and adding T-Rs

Rapping Sectionalization

- Adding Rappers Across Gas Flow
- Adding Rappers With Gas Flow

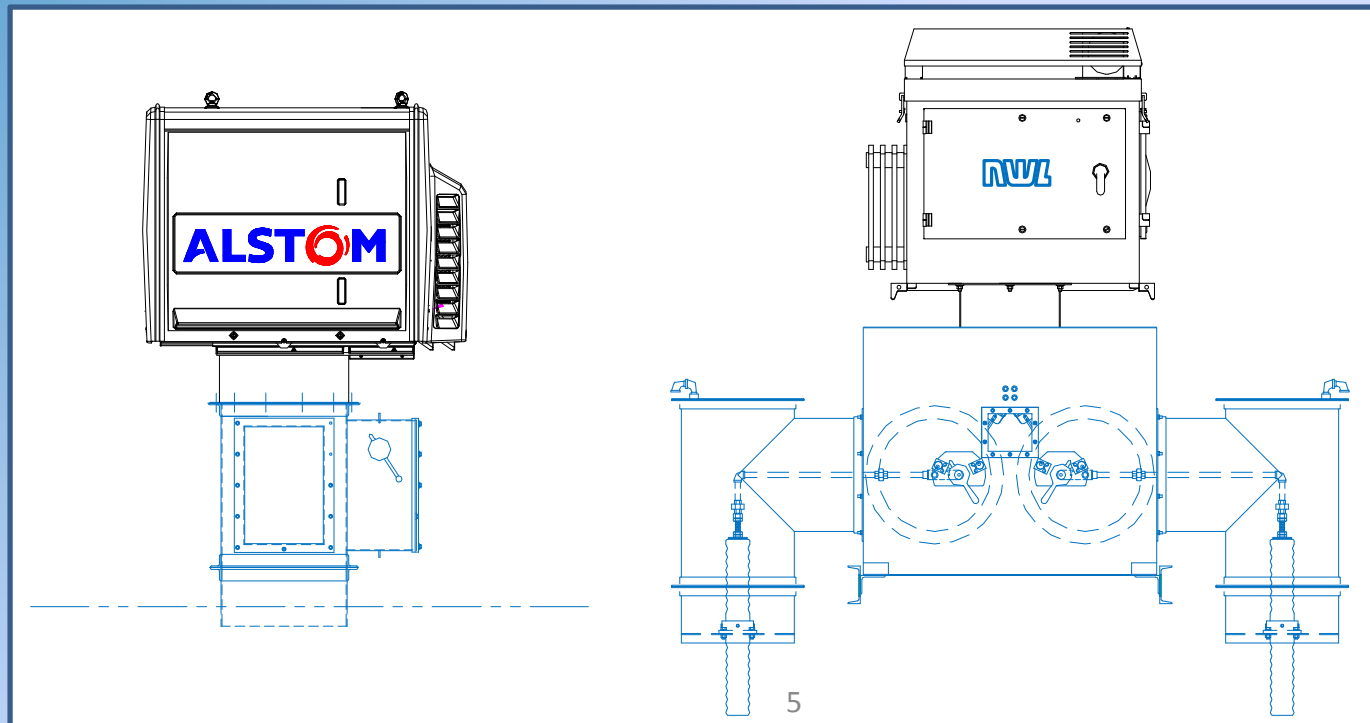


Leading Edge Rapping Only



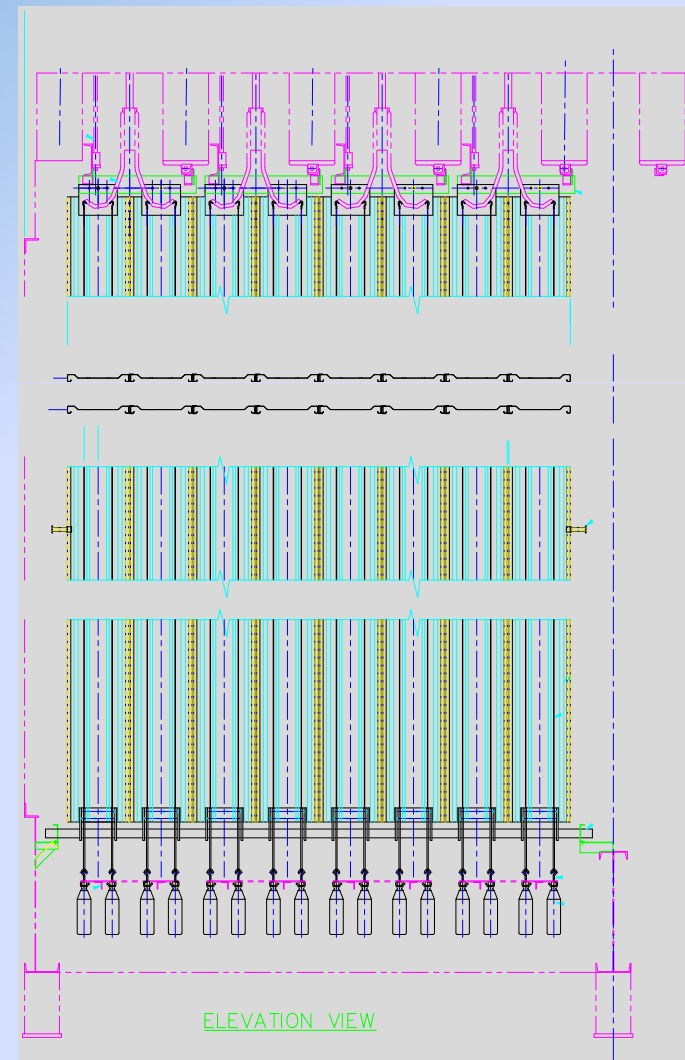
Repowering

- Adding / Converting to Switched Mode Power Supplies
- Adding/ Converting to Medium Frequency Control systems



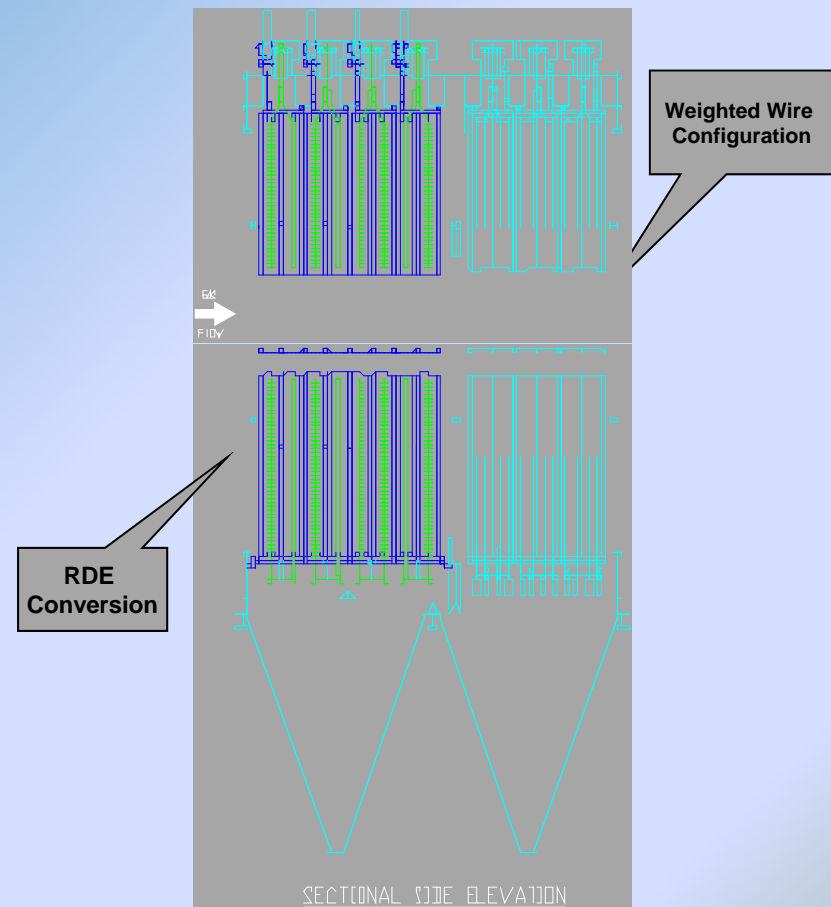
Rebuilding / Converting

- In – Kind Rebuild
- Conversion to Intermediate-Spaced Electrodes
- Conversion to Wide-Spaced Electrodes



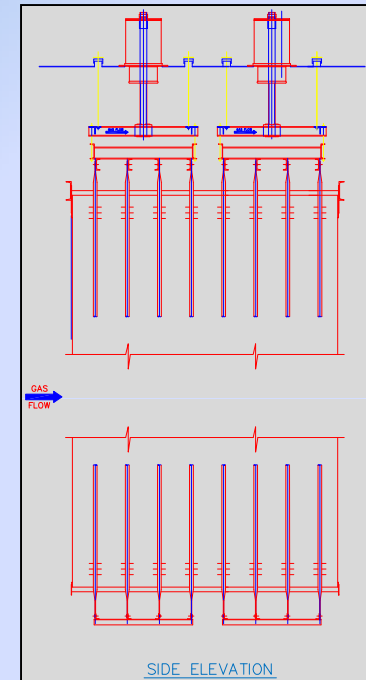
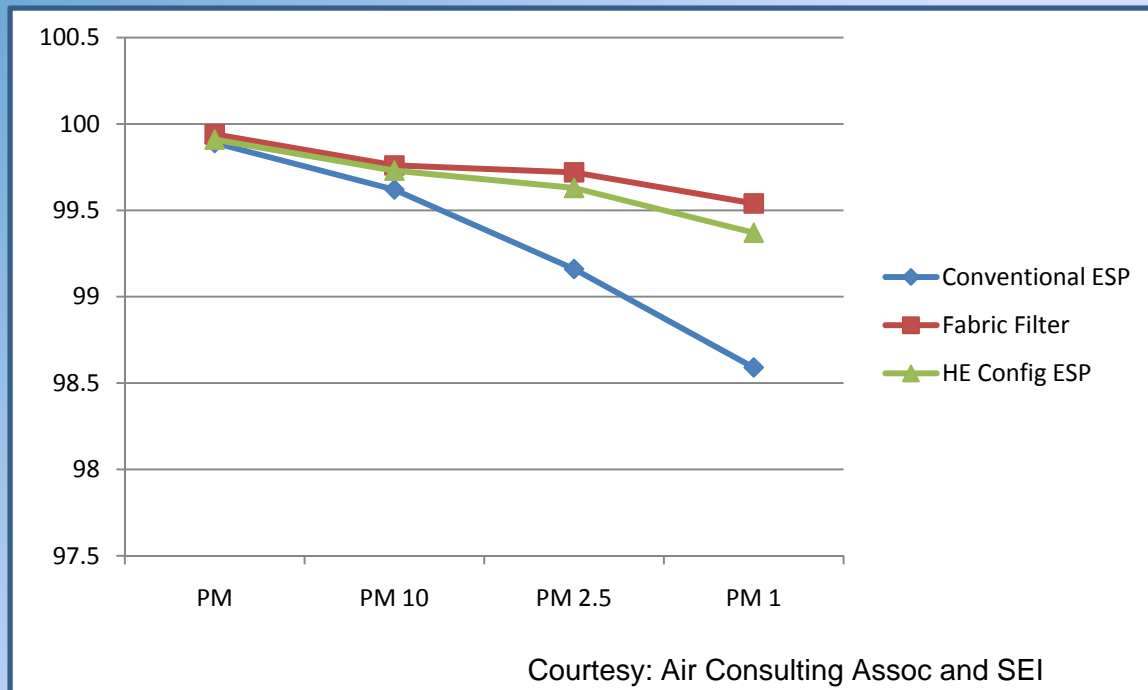
Rebuilding / Converting

- In – Kind Rebuild
- Conversion to Intermediate-Spaced Electrodes
- Conversion to Wide-Spaced Electrodes



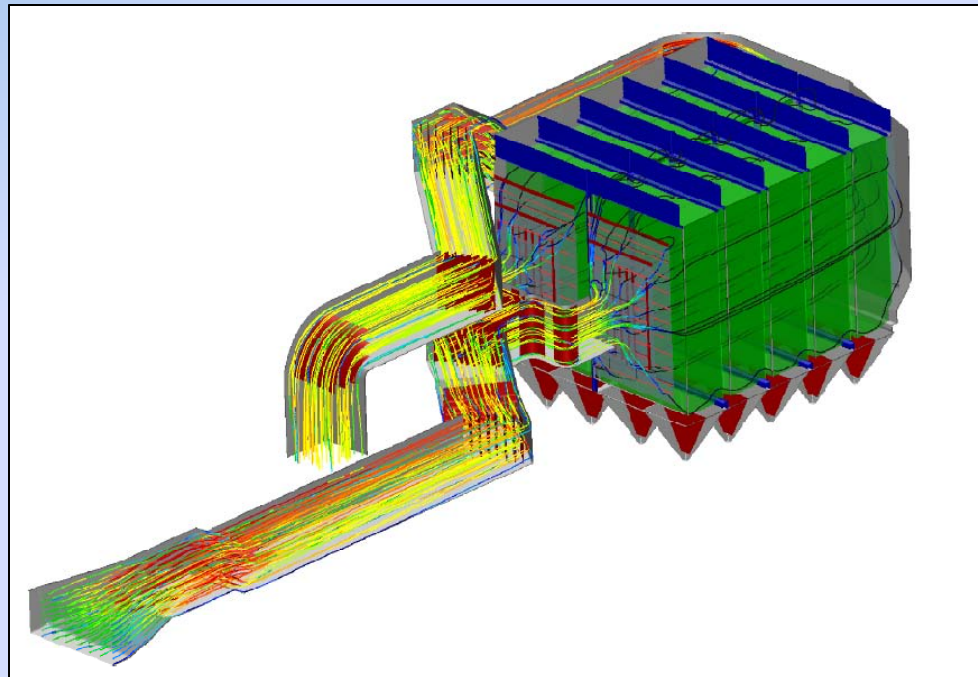
Rebuilding / Converting

- Conversion to Wide-Spaced Electrodes
 - Conventional
 - High Energy



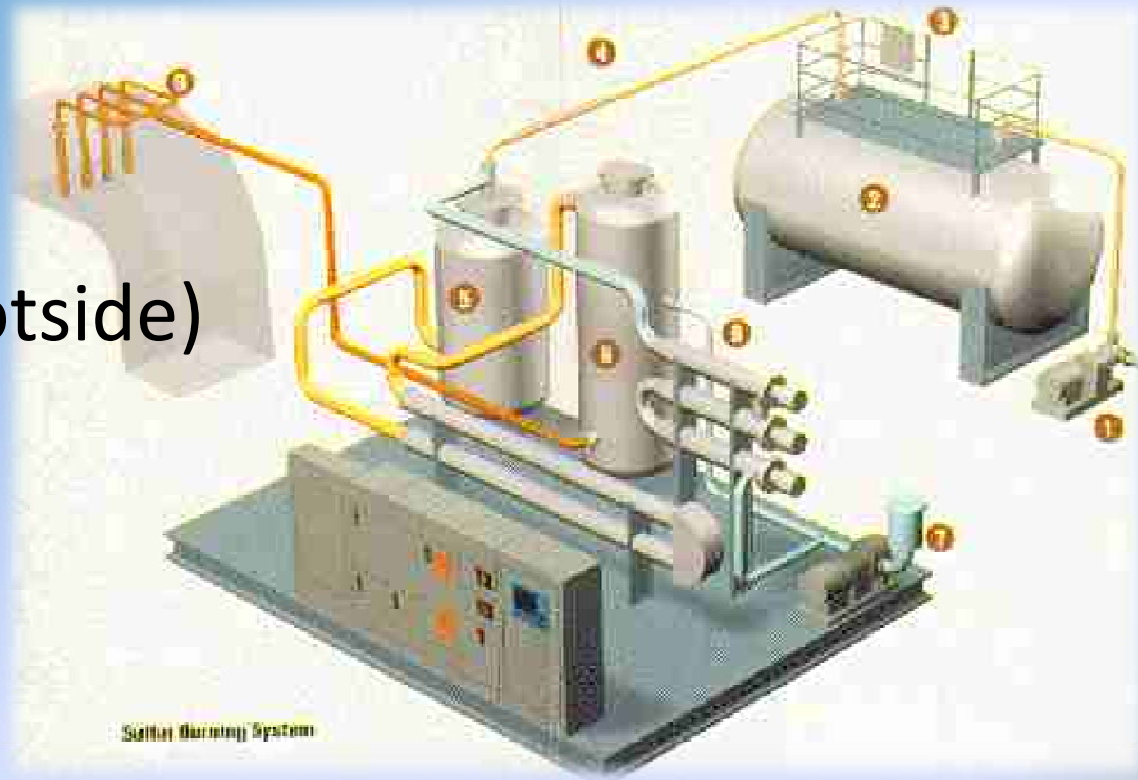
Flow Improvement

- Improve Flow Uniformity
- Improve Temperature Uniformity
- Reduce Reentrainment
- Reduce Sweepage



Gas Conditioning

- SO_3
- NH_3
- Trona
- Sodium (Hotside)



Collecting Area Expansion

- Taller
- Deeper
- Wider

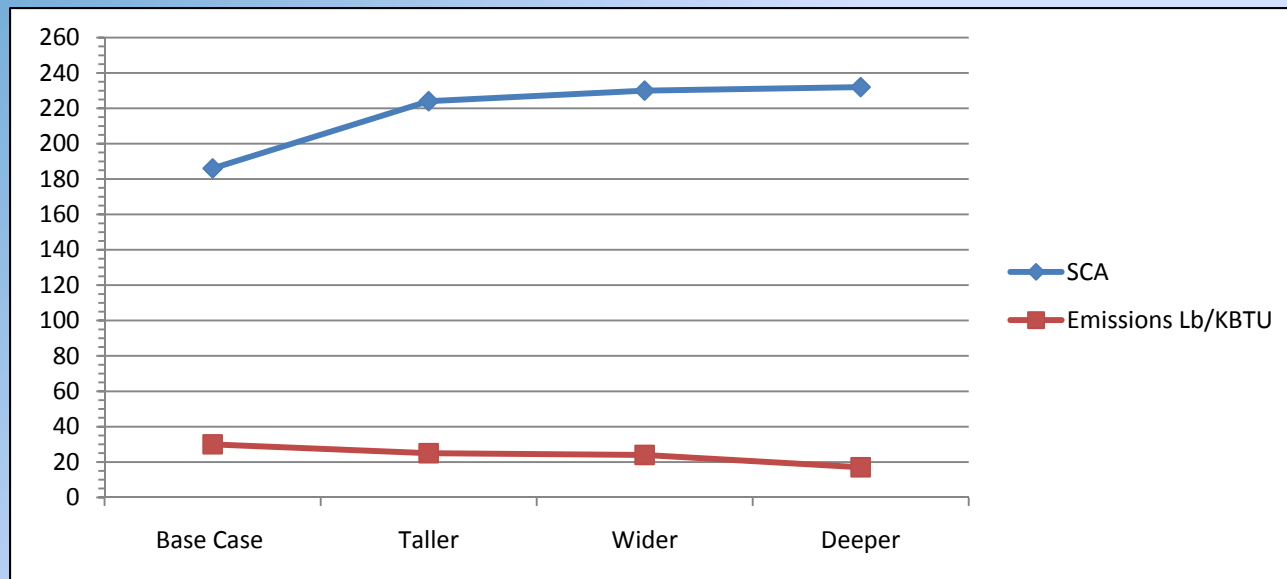


Relative Benefits of Various Approaches

| Activity | Relative Cost | Expected Improvement |
|---------------------------|---------------|----------------------|
| Power Sectionalization | Medium | Low to Significant |
| Rapping Sectionalization | Medium | Low |
| Repowering | Medium | Significant |
| Rebuilding / Converting | High | Significant |
| Flow Improvement | Medium | Significant |
| Gas Conditioning | Medium | Significant |
| Collecting Area Expansion | Highest | Most Improvement |

Relative Improvement Due to Expansion Types

| Case Number | Expansion | SCA | Emissions Lb/MMBTU |
|-------------|--------------------------|--------------------------------|--------------------|
| Base Case | N/A | 186 ft ² /1000 acfm | 0.030 |
| Taller | Expand from 30' to 36' | 224 ft ² /1000 acfm | 0.025 |
| Wider | Expand from 162' to 200' | 230 ft ² /1000 acfm | 0.024 |
| Deeper | Add 1 Field | 232 ft ² /1000 acfm | 0.017 |

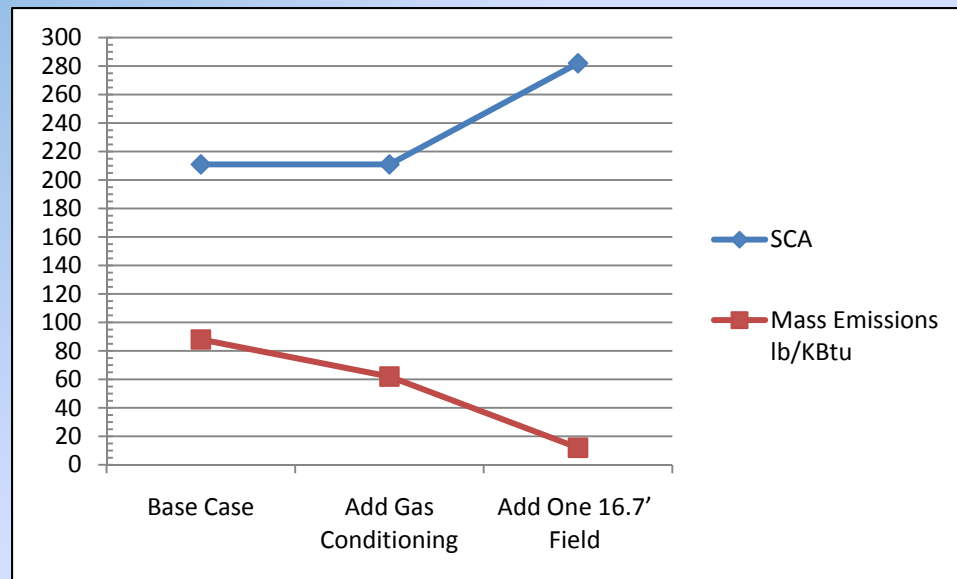


Three Cases:

| Case Number | Modification | Expansion |
|-------------|-------------------------|------------------|
| Case 1 | Gas Conditioning, etc | Additional Depth |
| Case 2 | Rearrange Flow, Rebuild | Additional Depth |
| Case 3 | None | Additional Depth |

Case 1

| Case Description | SCA | Mass Emissions | Opacity |
|----------------------|--------------------------------|----------------|---------|
| Base Case | 211 ft ² /1000 acfm | 0.088 Lb/MMBtu | 13.2 % |
| Add Gas Conditioning | 211 ft ² /1000 acfm | 0.062 Lb/MMBtu | 8.1 % |
| Add One 16.7' Field | 282 ft ² /1000 acfm | 0.012 Lb/MMBtu | 2.0 % |



Case 2

| Case Description | SCA | Mass Emissions | Opacity |
|--|--------------------------------|----------------|---------|
| Base Case | 370 ft ² /1000 acfm | 0.016 Lb/MMBtu | 9.7 % |
| Total Flow Through One Casing | 185 ft ² /1000 acfm | 0.024 Lb/MMBtu | 16.6 % |
| Total Flow Through One Casing and One New Casing | 352 ft ² /1000 acfm | 0.003 Lb/MMBtu | 1.6 % |
| Total Flow Through One Casing and One New Casing | 370 ft ² /1000 acfm | 0.003 Lb/MMBtu | 1.6 % |
| All Four Casings in Service | 704 ft ² /1000 acfm | 0.001 Lb/MMBtu | 1.1 % |

Case 2 Existing Configuration

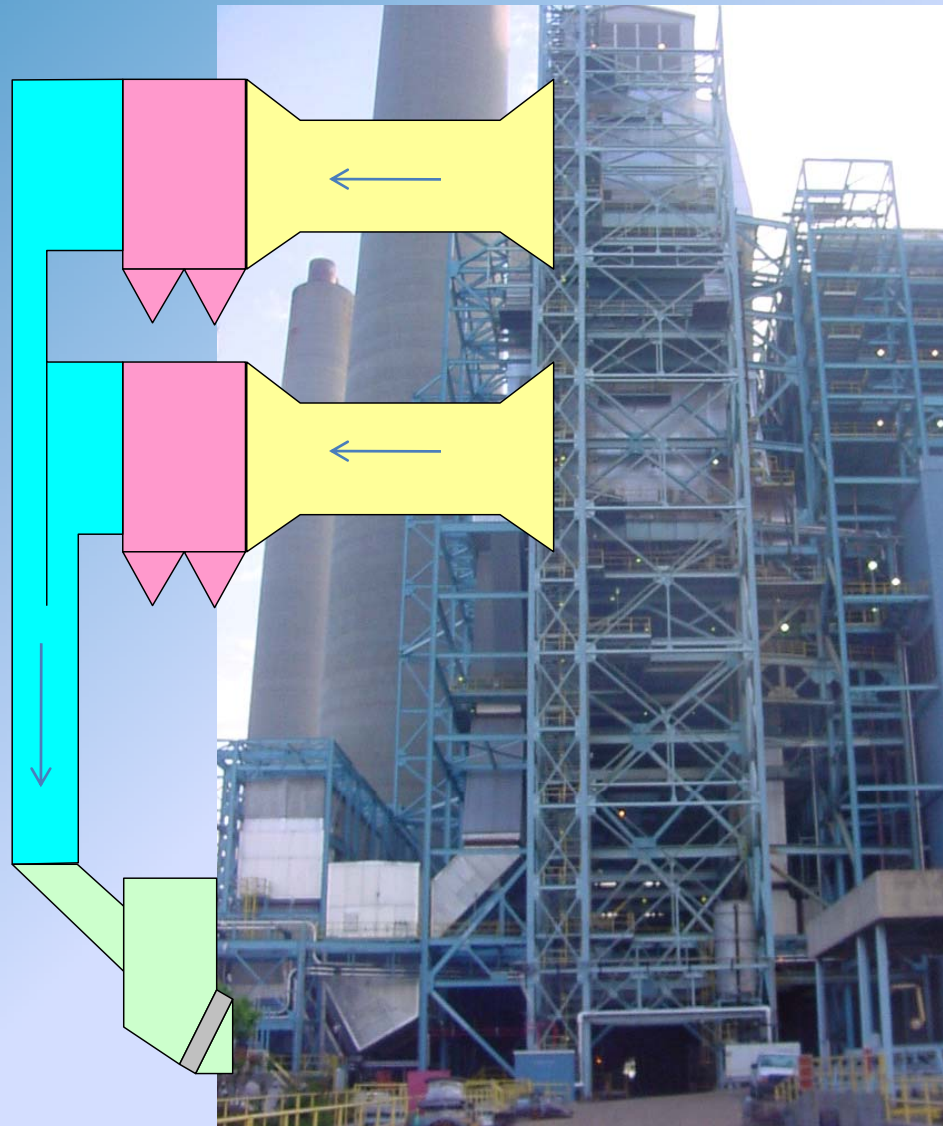


Lower ESP

Upper ESP

(#)

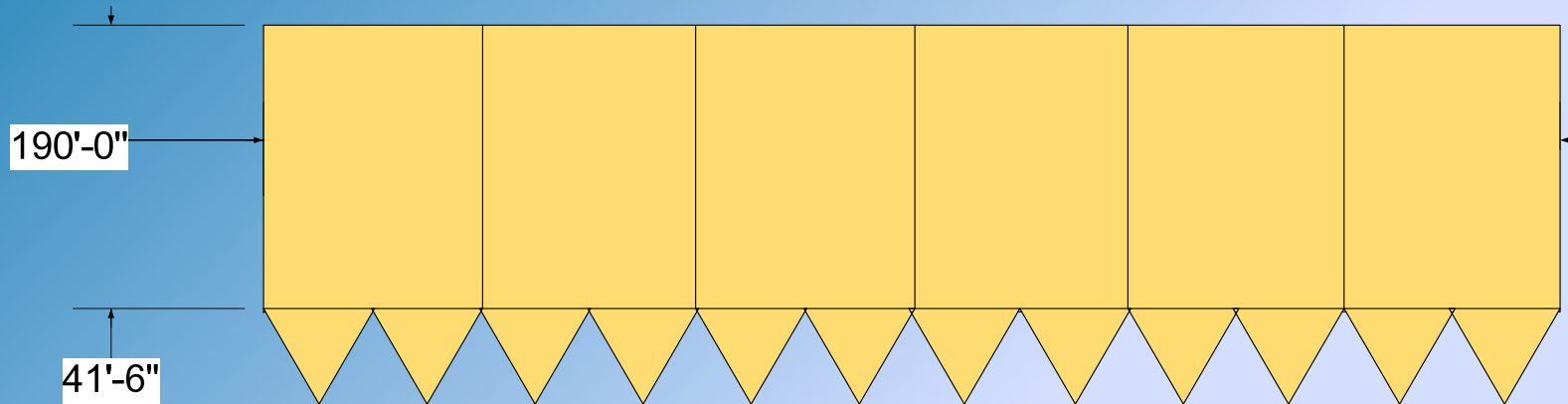
Case 2 – Short Outage Options



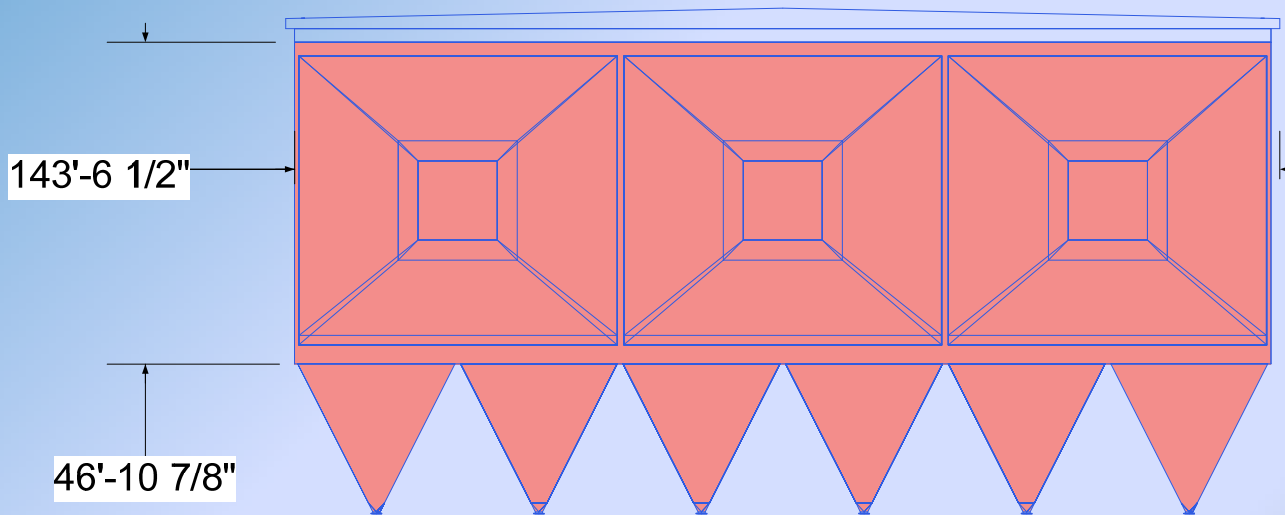
Case 3

| Case Description | SCA | Mass Emissions | Opacity |
|--|--------------------------------|----------------|---------|
| Base Case | 370 ft ² /1000 acfm | 0.016 Lb/MMBtu | 9.7 % |
| Add 5 Fields, 45' Tall at Ground Level | 690 ft ² /1000 acfm | 0.014 Lb/MMBtu | 4.7 % |
| Add 6 Fields, 45' Tall at Ground Level | 828 ft ² /1000 acfm | 0.003 Lb/MMBtu | 1.2 % |
| Add 6 Fields, 36' Tall at Ground Level | 662 ft ² /1000 acfm | 0.005 Lb/MMBtu | 2.0 % |

Relative Casing Cross Sections

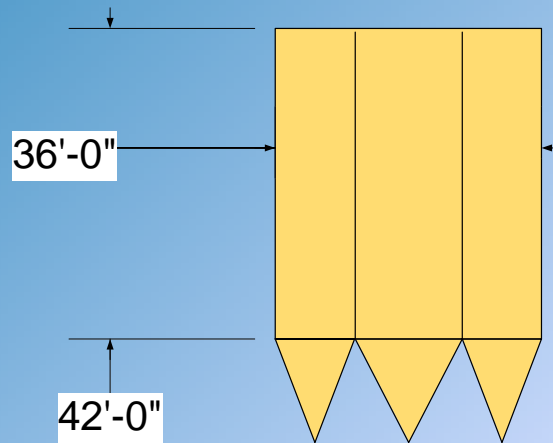


Elevation Transverse - Existing Buell Casing

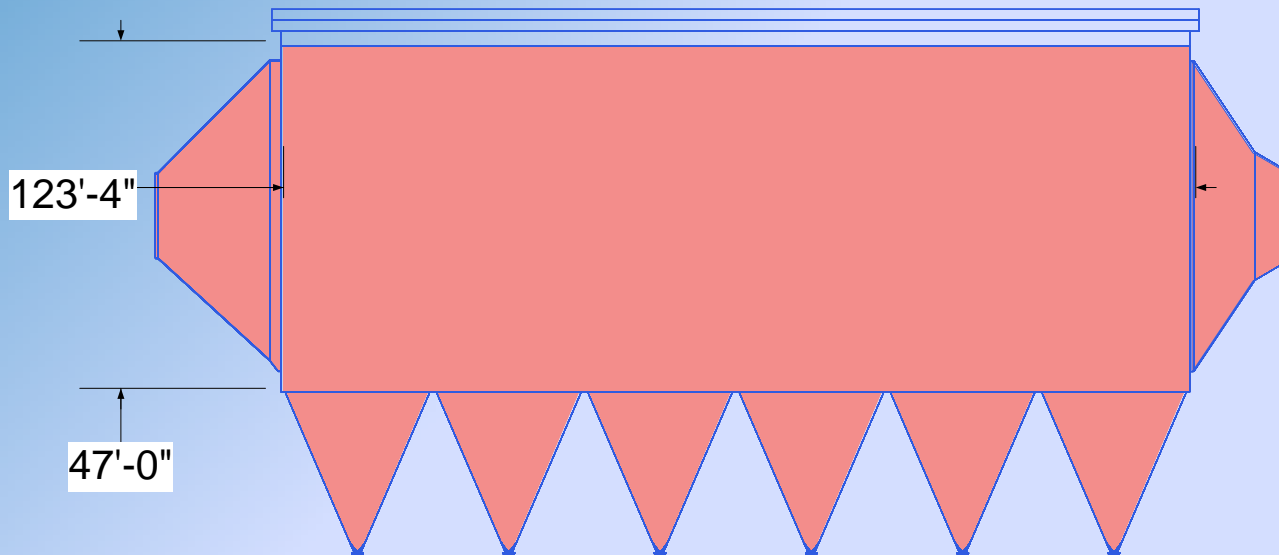


Elevation Transverse - Existing Flakt Casing,
Options 1,2,&3
(#)

Relative Casing Cross Sections



Elevation Longitudinal - Existing Buell Casing



Elevation Longitudinal - Existing Flakt Casing,
Option 3

What SCA is required to meet the EGU MACT in these cases?

| Case Number | Existing Outlet Mass Emissions | Existing SCA | Needed SCA to Achieve 0.013 Lb/MMBTU |
|-------------|--------------------------------|---|---|
| Case 1 | 0.081 lb/MMBtu | 375 ft ² /1000 acfm No Gas Conditioning | 501 ft ² /1000 acfm With SO ₃ Gas Conditioning |
| Case 2 | 0.081 lb/MMBtu | 375 ft ² /1000 acfm No Gas Conditioning | 563 ft ² /1000 acfm No Gas Conditioning |

Summary

- Improving performance of aging ESPs is possible at two levels; In space and expansion of space.
- In space improvements are generally possible through upgrades of existing equipment or conversion to newer technology.
- Expansion of space is possible depending on various factors such as ground area availability, ducting, and impact to other equipment such as ID fans.
- Expansion of space can be done in three ways, each having different cost and performance benefits.