



CLYDE BERGEMANN EEC

Precipitator Efficiency Improvement

August 25, 2011

ESP Performance Improvements can be done via two paths, or a combination of both:

- **Modifications or Enhancements to Existing ESP**
- **Structural/Physical Changes to ESP Size**

Improvements presented are based on estimated reduction in emissions

Enhancements to Existing ESP

Good Maintenance!

- Are the internals aligned?
- Are all rappers working?
- Are T/R controllers working and optimized?
- Are T/R signals calibrated and working at controller?
- Are all meters working?
- Is ash removal system working?
- Are all insulators clean?
- Have any leaks been eliminated?

Improvements 5-10% dependent upon work done

Enhancements to Existing ESP (cont.)

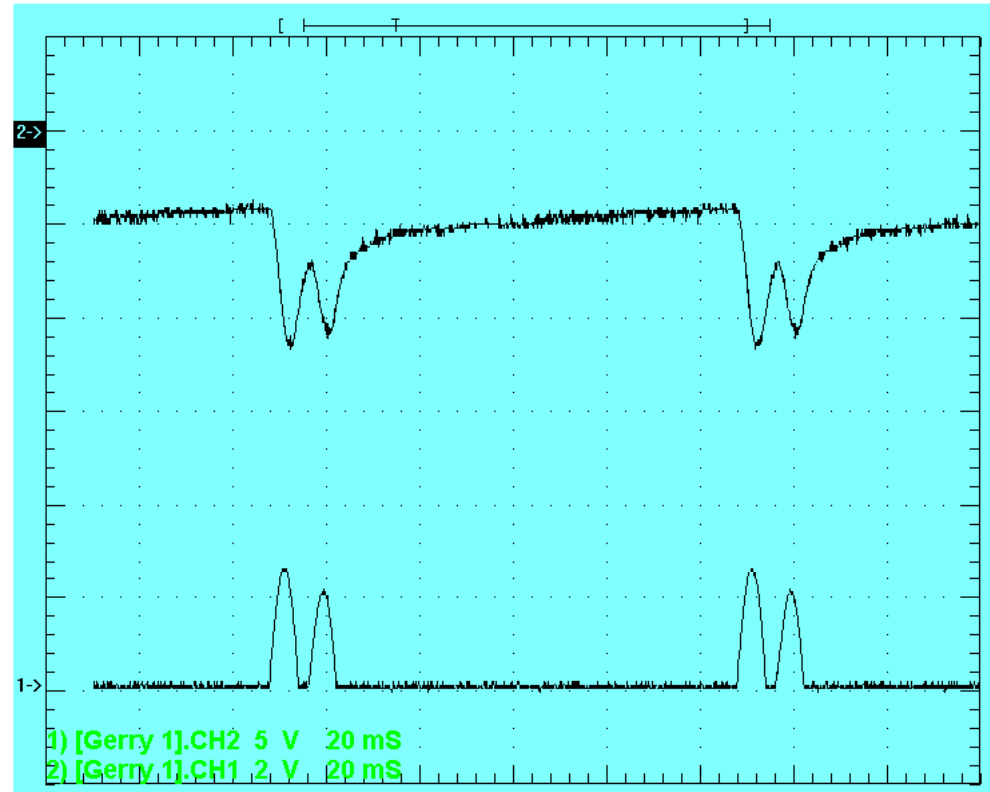
- **Power supplies**

- **Conventional T/R's and controls – upgrade to newer controls**

- IE
- Pulsing

- **Higher frequency power supplies**

- Mid frequency
- High frequency



Improvements 10-30% dependent upon increase in power

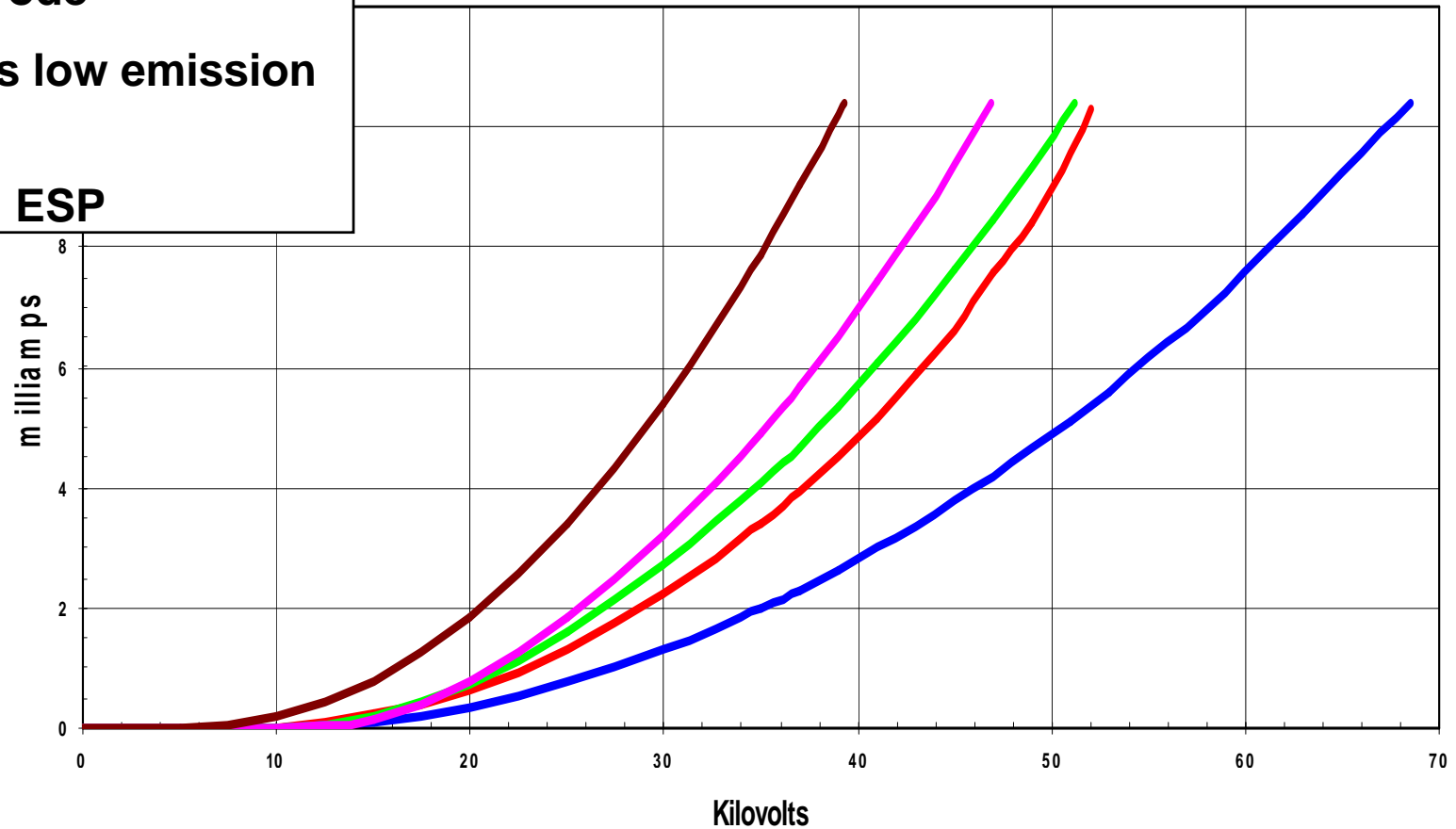
Enhancements to Existing ESP (cont.)

Improvements 5-10% based upon degree of change-out

- **Discharge electrode design**

- Rigid electrode
- High versus low emission electrode
- Location in ESP

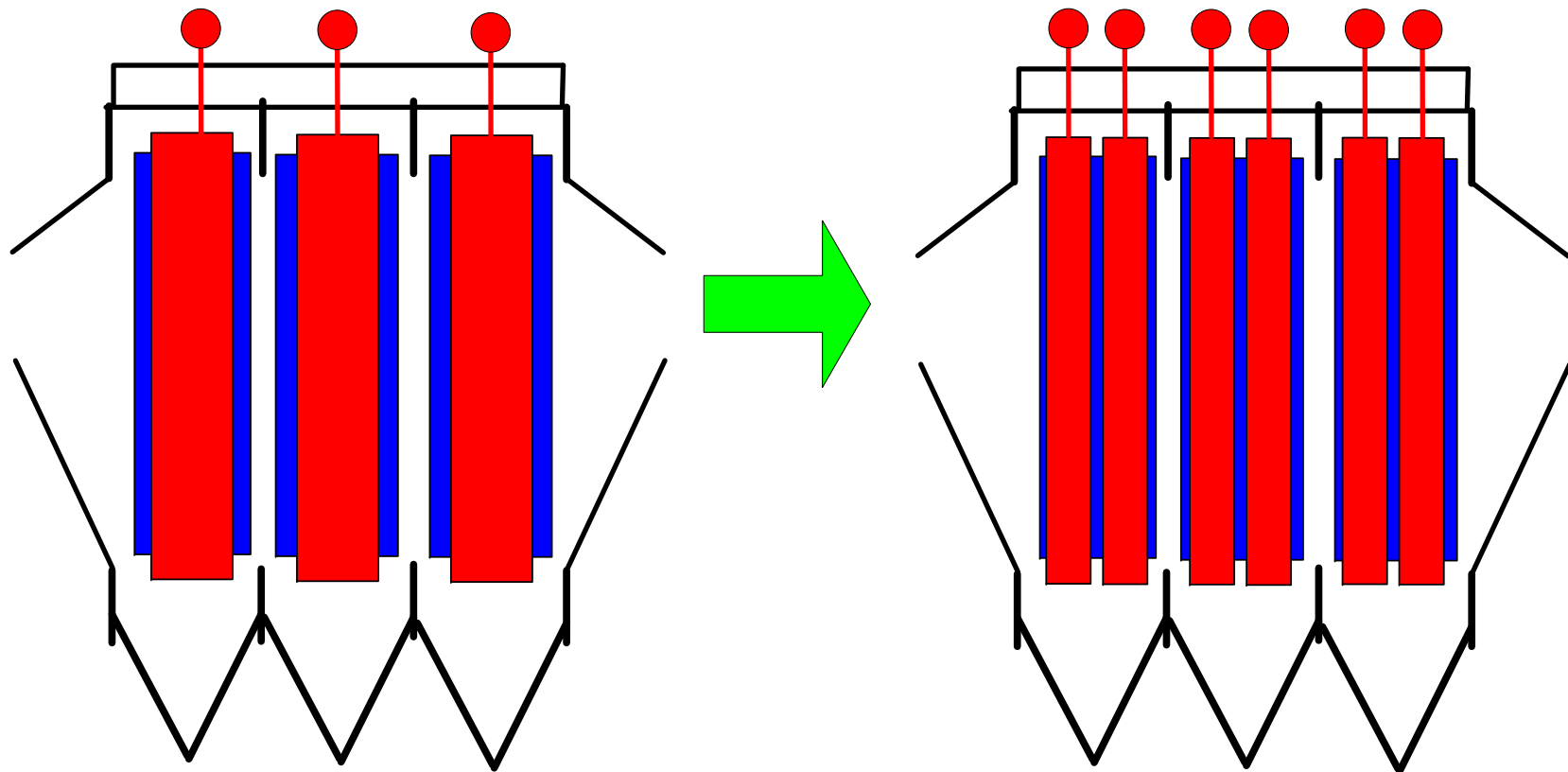
VI-Curve for 5 Electrode Configurations



Enhancements to Existing ESP (cont.)

- Electrical field sectionalization

Improvements 5-20%
based upon degree of
sectionalization



Enhancements to Existing ESP (cont.)

- **Optimized rapping program**

- **Opacity charts to evaluate rapping**

- Rapping spikes
- Localized rapping issues
- Excessive rapping

- **Power Levels to ensure good and consistent voltage-current relationship**

- Increase in current/drop in voltage
- Increase in voltage/drop in current

Improvements 5-10% based upon starting point of optimization

Enhancements to Existing ESP (cont.)

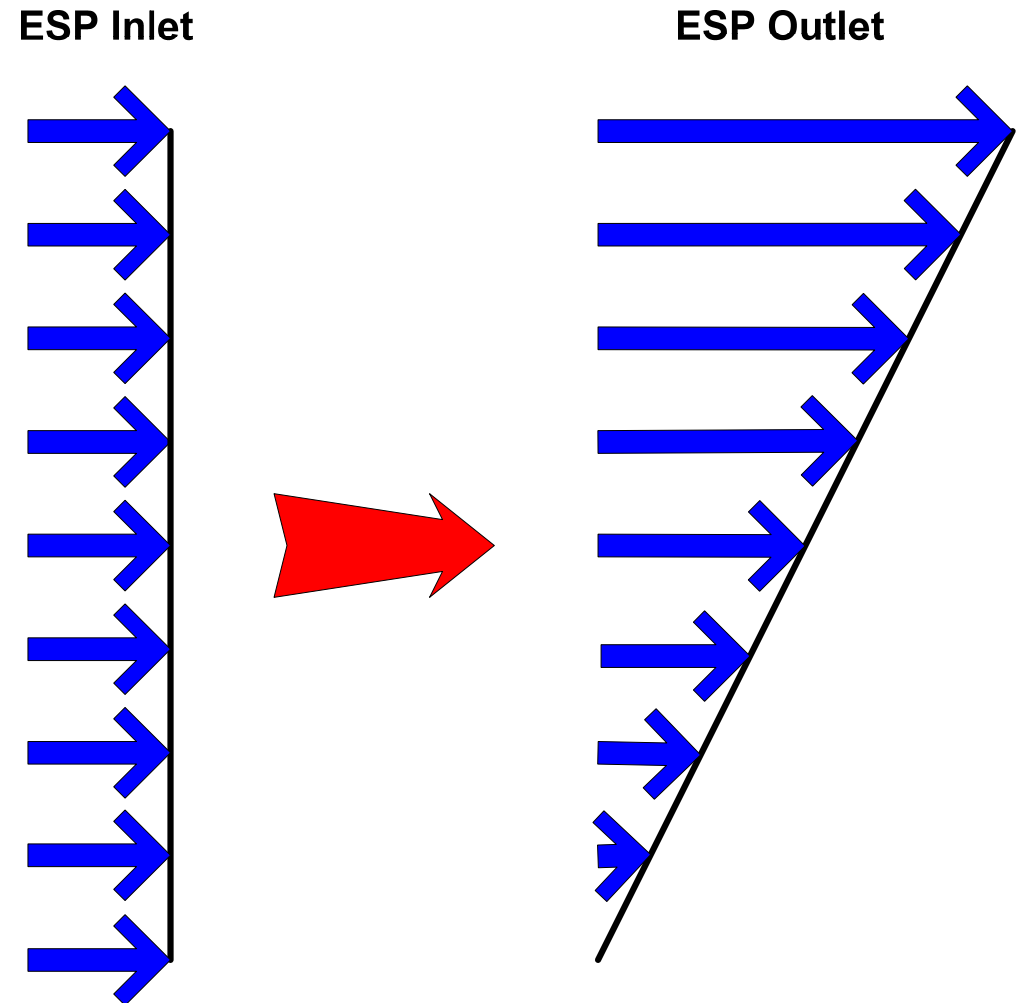
- **Review Gas Distribution**
 - ICAC guidelines
 - Skewed gas flow
- **Minimize Sneakage**

Improvements 5-10% based on degree of maldistribution

ESP Performance Improvement

Skewed gas flow:

- **Bias flow into upper regions of ESP**
 - Higher gas flow at top of ESP
 - Majority of dust in bottom region of ESP
 - Hopper re-entrainment

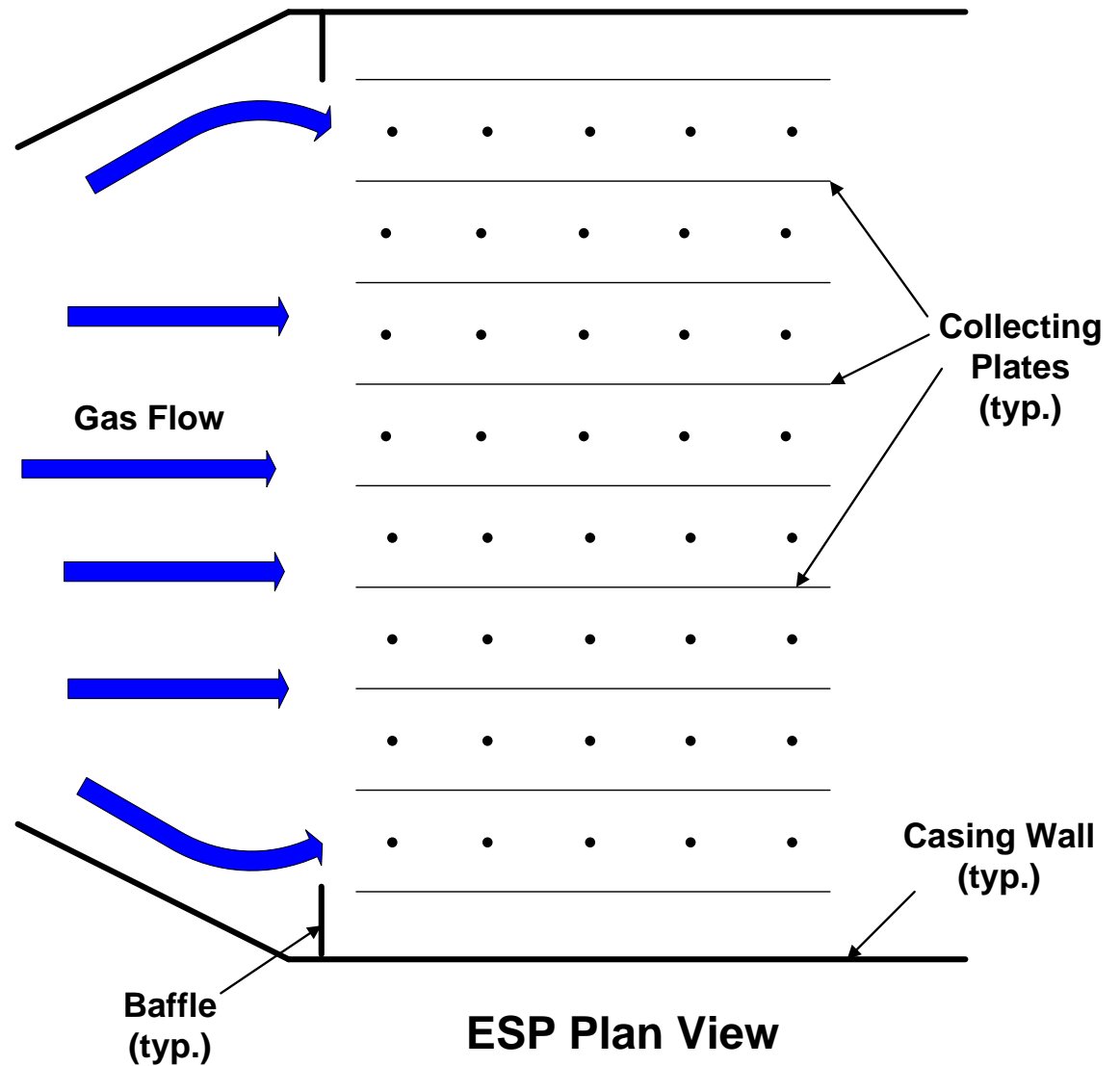


ESP Velocity Profile (Elevation)

ESP Performance Improvement

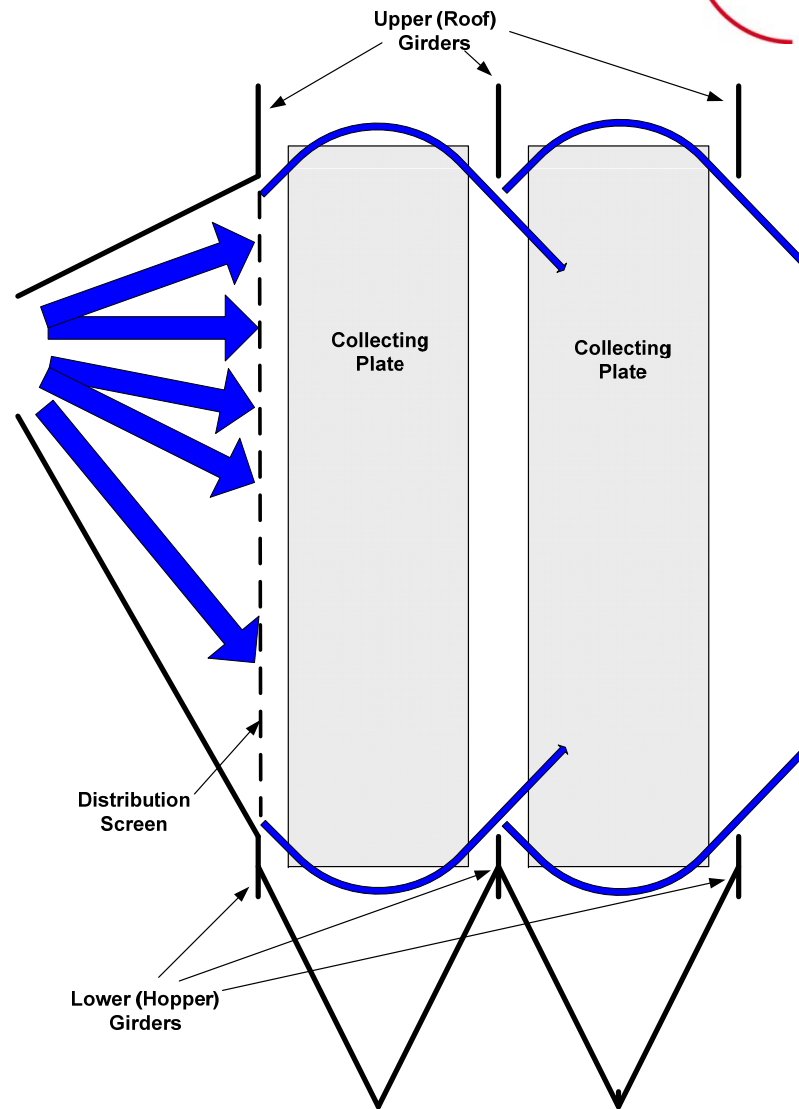
Sneakage: Prevent Flue gas from by-passing treatment zone

- **Vertical baffles**



ESP Performance Improvement

- Upper and lower girder extensions



ESP Side Elevation

Enhancements to Existing ESP (cont.)

Summary:

- **Good Maintenance**
- **Power Supplies**
- **Discharge Electrode Design**
- **Sectionalization**
- **Optimize Rapping**
- **Review Gas Distribution**
- **Minimize Sneakage**

Note: Improvements are not completely additive – there is a practical limit to how much improvement one can achieve out of an ESP

Structural/Physical Changes to ESP Size

- **Increase plate height**
 - **Increase collecting area**
 - **Lower gas velocity and increase residence time in treatment area (if no change in volume)**
 - **Requires change in discharge electrodes to match new height**
 - **Need to evaluate structurally the casing/support steel**
 - **May need to increase T/R sizes**

Structural/Physical Changes to ESP Size (cont.)

- **Add field at inlet or outlet**
 - ➔ Increase collecting area
 - ➔ Increase sectionalization by adding fields
 - ➔ Increase residence time in treatment area (if no change in volume)

- **Additional chamber**
 - ➔ Size dependent upon level of performance improvement desired
 - ➔ Space constraints
 - ➔ Ductwork issues

Thank you!

