Approaches to Improve ESP Performance

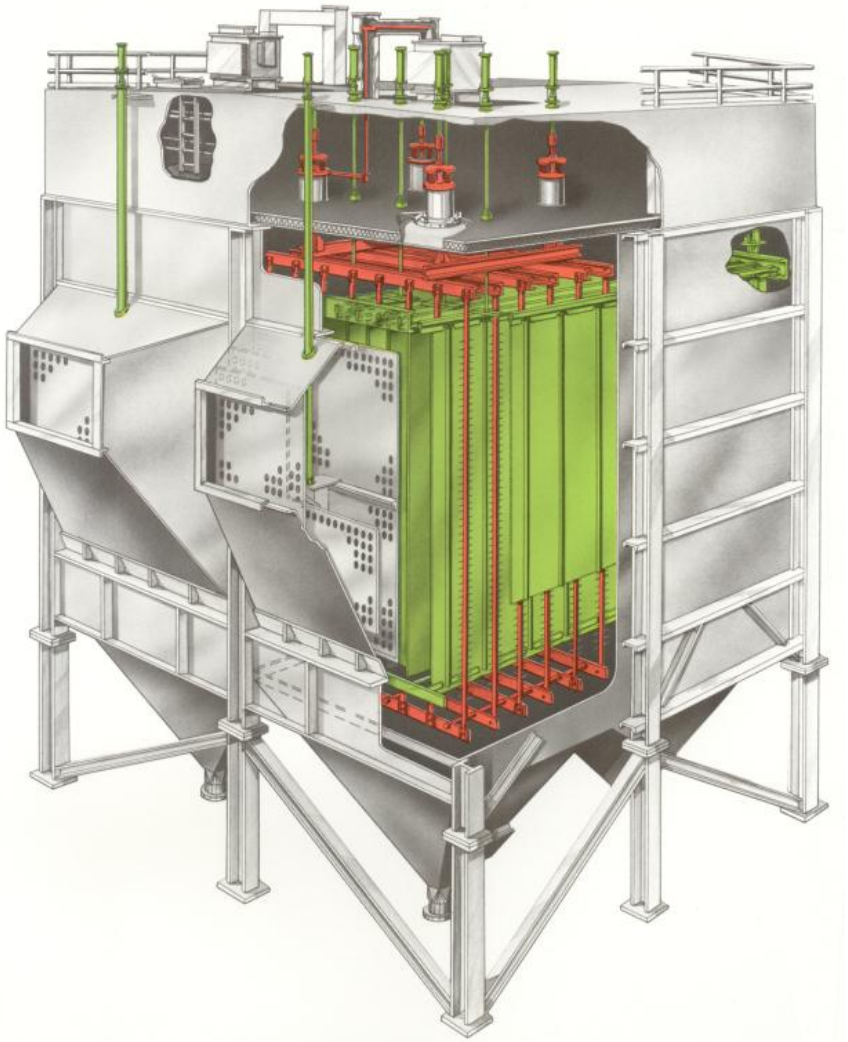
Summary: Improve ESP Performance

Design Criteria	UPGRADE Options:
Increase Collecting Area	Rebuild with Taller Plates Add a Field or Chamber
Increase Migration Velocity	Upgrade Control Systems & Power Supplies Restore Electrical Clearances Sectionalize Electrical Fields
Reduce Gas Flow to the ESP	Reduce Gas Steam Temperatures Reduce Production Improve Gas Flow

NOTE: The above information assumes the existing ESP is in satisfactory condition and maintained. If not, then the first step is to perform a detailed inspection and do required repairs.

ESP Performance Improvement

- 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



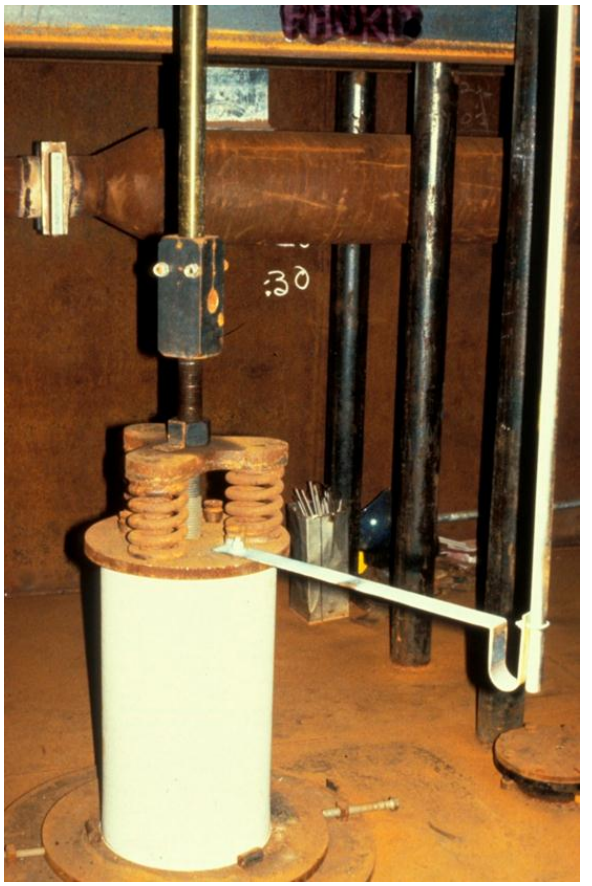
To Upgrade or Replace???

- Major Factors To Be Considered:
  - ➔ Site Real Estate Restrictions
  - ➔ New Performance Requirements or Emission Control Requirements (State & Federal)
  - ➔ Sorbents and Additives That May Impact Performance
  - ➔ Outage Time Available
  - ➔ Life Cycle Of The Unit
  - ➔ Long Term Static Fuel Supply or Is Flexibility Required
  - ➔ Is The Current ESP Mechanically Reliable & Sound (corrosion)

Step #1: Fix what is broken

Common issues with existing ESPs

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

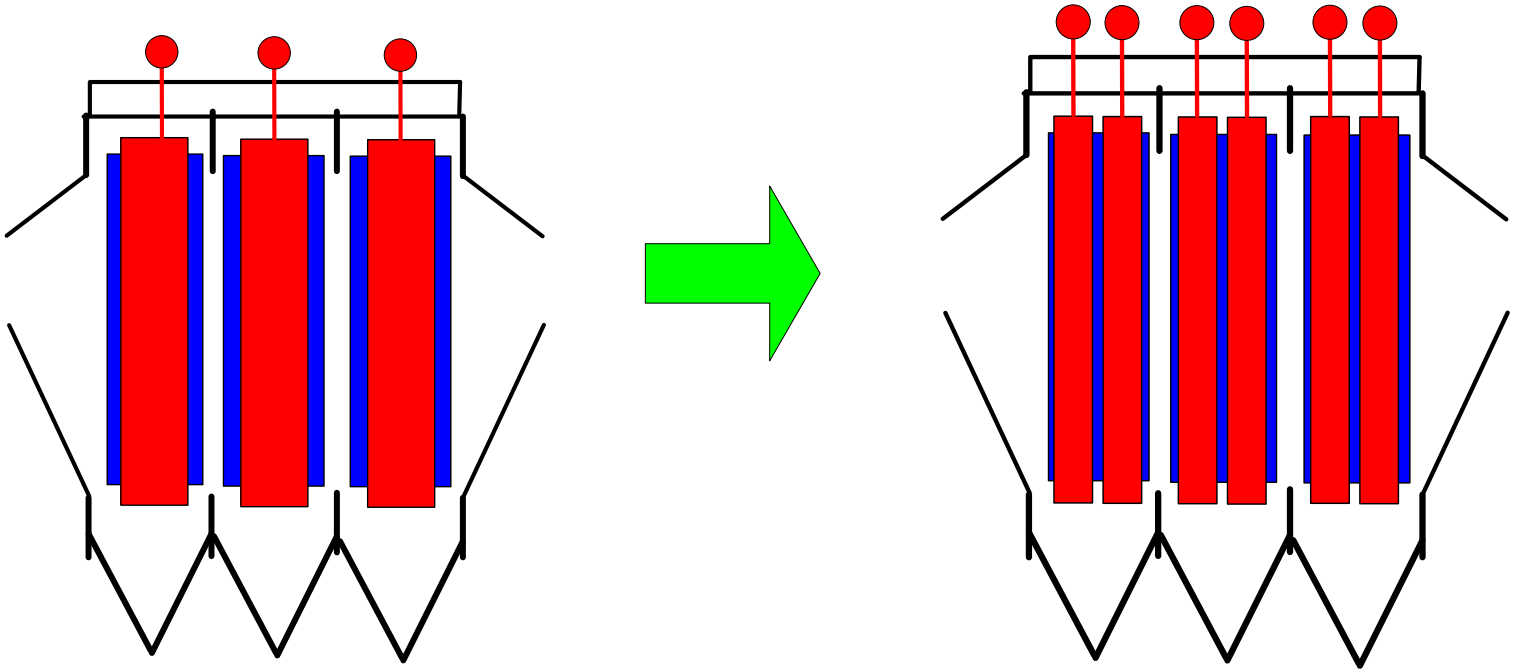


Available Upgrades for Existing ESP's

- Enhanced Power Supplies
  - ➔ Electrical Sectionalization
  - ➔ Higher capacity Power Supplies and High frequency switch mode controls
- Customized rigid discharge electrodes for maximum particle charging
- Wider plate spacing increase power for collection
- Optimized and customized rapping programs
- Proper gas distribution throughout ESP

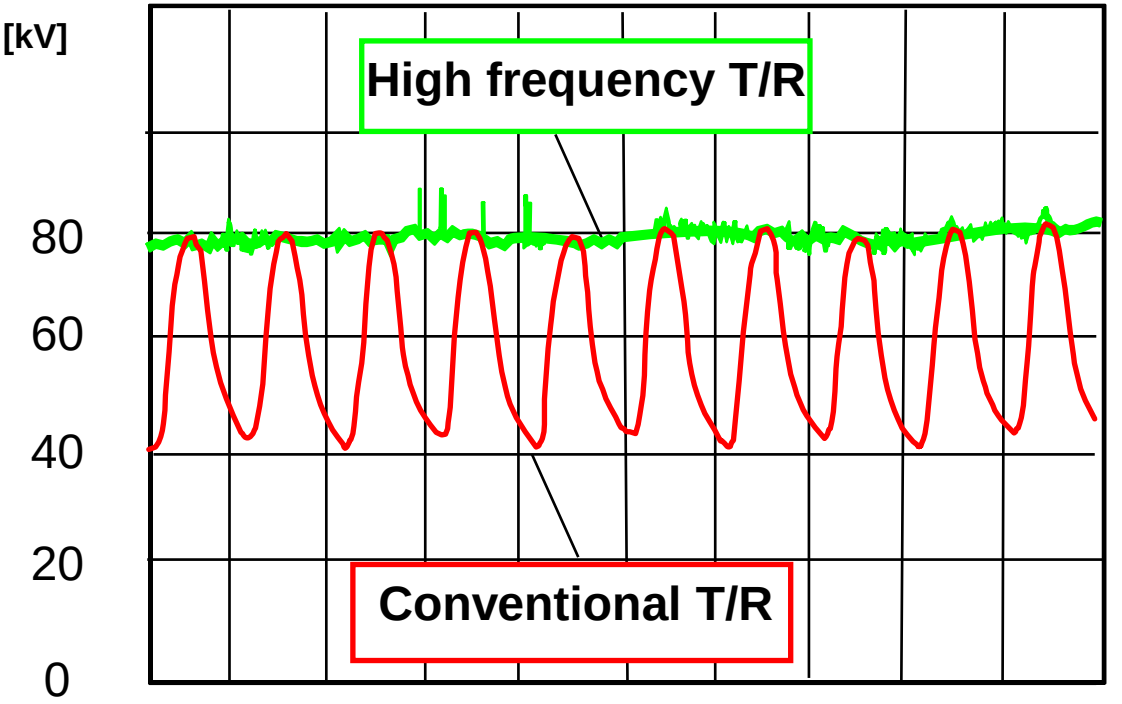
Electrical Field Sectionalization

- Powering sections of the precipitator by adding HV frames and more TRs is called “splitting fields”
- High particulate loading in the inlet field usually causes high spark rates, which leads to frequent quenching of the entire field
- Splitting fields leads to only a portion of the given HV section being quenched in response to sparking



Upgrading Power Supplies

- Conventional T/R designs
  - ➔ Industry standard, Reliable, Most prevalent design
- High frequency power supplies
  - ➔ Increased average precipitator voltage and better collection efficiency



Rigid Discharge Electrodes & Plate Spacing

- Bolted connection
  - ➔ Continuous single piece tube requires no assembly
  - ➔ Various pin configurations provide desired corona densities for specific application
- Eliminate downtime from broken electrodes
  - ➔ Common with weighted wire electrodes
- Stable high voltage frame has closed ends to prevent build-up of PM
- Most energy-efficient rigid electrode available
- Widened Collecting Electrode Plate spacing

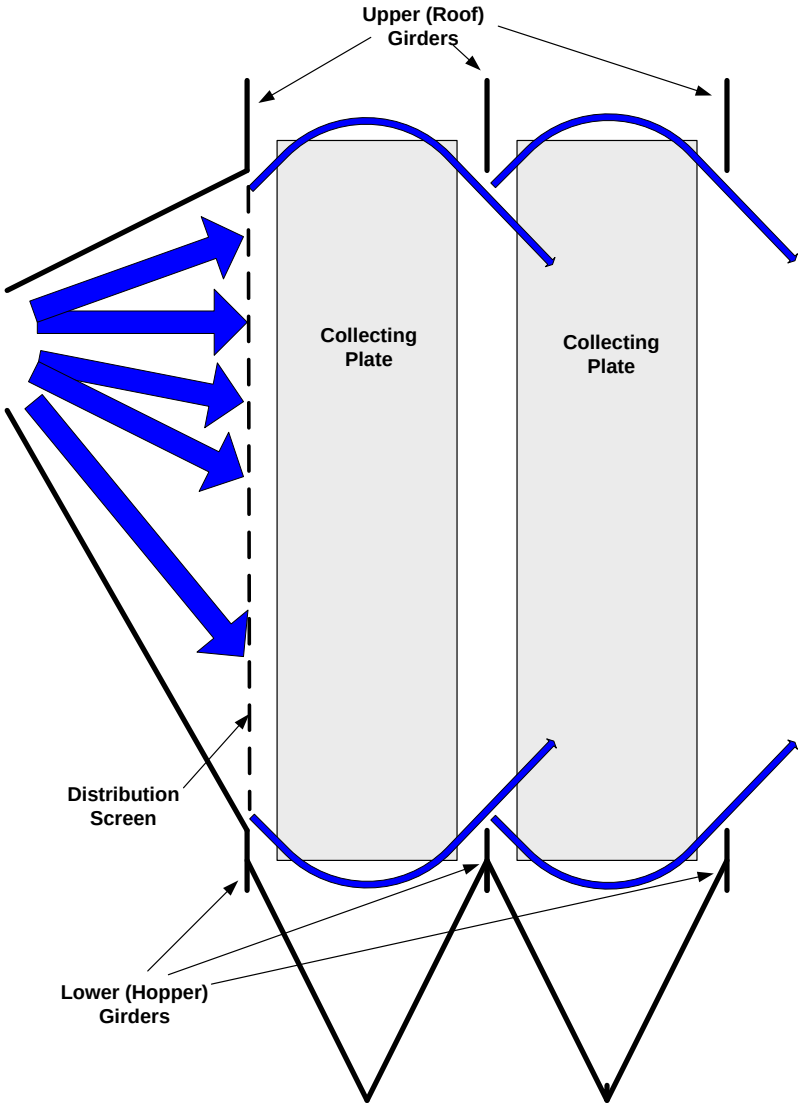
Optimized Rapping Program & Equipment

- Opacity charts to evaluate current rapping
  - ➔ Opacity spikes due to rapping
  - ➔ Localized rapping issues
  - ➔ Excessive rapping
- Properly adjusted rappers
  - ➔ Intensity - Up to 20 ft. lbs. force
  - ➔ Cycle time
  - ➔ Multiple rap
- How are the plates, frames, and electrodes being rapped???

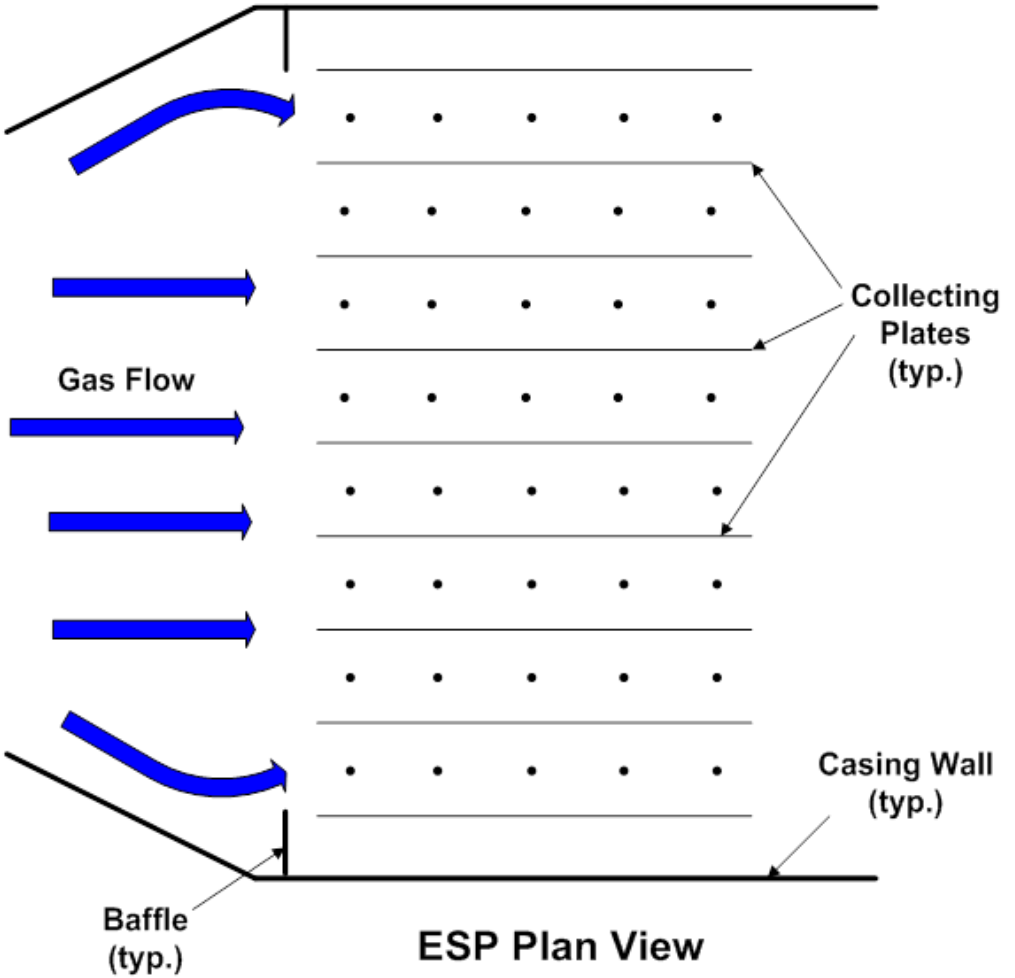
Improved Gas Distribution

- Determining the proper distribution of gas for maximum collection efficiency
  - ➔ Need to maintain gas within treatment zone
- Other factors to consider:
  - ➔ Condition of inlet perforated plate
  - ➔ Hopper dust reentrainment
  - ➔ Sneakage out of the treatment zone
- Tools:
  - ➔ Start with a proper CFD model of the current ESP design
  - ➔ Vertical Baffles and girder extensions
  - ➔ Rapping of perforated plate

Anti-Sneak Baffles



ESP Side Elevation



ESP Plan View

Enhancements to Existing ESP - Summary

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

*** These upgrades are a less expensive option for the overall benefit gained.

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

Structural Changes to the ESP Casing

Increased ESP Plate Height

- Increase collecting area of ESP
- Lower gas velocity and increase residence time in treatment area (if no change in gas volume)
- Factors to consider:
  - ➔ Clearance issues over the ESP
  - ➔ Collecting area Aspect Ratio (length vs height)
  - ➔ Requires change in discharge electrodes to match new height
  - ➔ Need to evaluate structurally the casing/support steel
  - ➔ May needto increase T/R sizes

Additional ESP Field/Chamber

- Add field at inlet or outlet of existing ESP
  - ➔ Increase collecting area
  - ➔ Increase sectionalization (mechanical and electrical) 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

Value Added Services

- Outage Inspections
  - ➔ Report write-up
- Recommended spares for ESPs
  - ➔ Develop proposal for recommended spare parts
- Solution development assistance
  - ➔ Tightening emissions requirements
  - ➔ Diagnose ongoing performance issues
- Wipe and Cleans
- Complete refurbishment/replacement projects

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