Approaches to Improve ESP Performance
## Summary: Improve ESP Performance

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**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

Upper (Roof) Girders

Collecting Plate

Collecting Plate

Distribution Screen

Lower (Hopper) Girders

Gas Flow

ESP Plan View

Collecting Plates (typ.)

Gas Flow

Casing Wall (typ.)

Baffle (typ.)
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 need to 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