Worldwide Pollution Control Association

FirstEnergy ESP Seminar

November 27th – 28th, 2007

Visit our website at www.wpca.info

Electrostatic Precipitator Inspections

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Inspections

- **Purpose**
  - **Prepare for Annual Maintenance Outage**
  - **Correct deficiency in a field**
  - **Investigate an abnormal power reading**
  - **Observe rapping changes and dust layers**
  - **Check effects of operational changes**
- **Type**
  - **“Dirty” Inspection**
  - **“Clean” Inspection**

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Types of Inspections

- "Dirty" Inspections
  - Investigate rapping effectiveness
  - Observe rapping changes and dust layers
  - Observe corrosion and in-leakage patterns
  - Gas distribution abnormalities
  - Reaction to fuel switching
  - Observe hopper levels

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Types of Inspections

- **“Clean” Inspections**
  - **More thorough casing inspection**
  - **Alignment and re-inspection**
  - **Ultrasonic testing of components**
  - **Condition of electrodes and plates- corrosion & erosion**

Short Outage Inspections
"Dirty"

- Spot check
- Quick walk through
- Walkways only
  - Be careful of walkway inspections
  - It is easy to miss things

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Long Outage Inspections
"Dirty" and "Clean"

- Top to Bottom
- Inlet to Outlet
- Inlet ductwork and nozzles
- Outlet ductwork and stack breeching
- All insulator surfaces
  - Internal and external
- Climb all the way to the top
- Hoppers

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“Dirty” Inspection

Gas Distribution

- Build-up Patterns
- Indications of abnormal flow
- Inlet & Outlet Nozzles
- Inlet Field
  - Polishing-High velocities

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“Dirty” Inspection
Dust Build-up Patterns

- Discharge Electrode
- Collecting Plates
- Walkways
- Structural members
- Casing sidewall and low flow areas
- Dust distribution across flow
- Dust distribution through fields

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“Dirty” Inspection
Evidence of Sparking/Arcing

- Electrode damage
  - Erosion
  - Failures
- Collecting plate damage
  - Holes
  - Loss of edges
- Localized Clean Spots
- Arc marks

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“Dirty” Inspection
Air Infiltration

- Abnormally clean or dirty areas
  - Scouring or grooves in dust layers
- Door Gaskets
- Expansion joints
- Weld failures
- Corrosion damage
- Hopper ash conveying system

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“Dirty” Inspection
Alignment

- General clearance review
  - Every passage
  - Top to bottom
  - Front to back
  - Inlet and outlet edge of field

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“Dirty” Inspection

- Uneven build-up patterns
- Changes in a particular area
  - Caused by expansion
  - Physical restriction
- Rapper induced alignment
  - Off-center impacting
- Collecting plates
- Discharge electrodes
- System view
  - Plates and electrodes with respect to each other

“Dirty” Inspection
Insulators

- Condition-type
- Tracking
- Condensation
- Type of layer
- Cleanability
- Quick dry wipedown
- Thorough cleaning and inspection inside and out

“Dirty” Inspection
Corrosion

- Condensation
- Inleakage-cooling
- Localized conditions-weather side
- Damage
- Cause and effect

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“Dirty” Inspection
Dust layers

- Flow patterns
- Electrode patterns
- Rapper malfunction
- Process caused abnormalities
- Boiler tube leaks
- Gas conditioning - SCR on/off
- Change in fuel – ash changes

“Clean” Inspection

- Evidence-finding the unseen
- Alignment
  - Poor clearances
  - Erosion damage
- Corrosion damage
  - Obvious corrosion
  - UT testing
- Cracks and damaged welds
  - Collecting electrodes & plates
  - Casing
- Improve short term performance

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“Clean” Inspection

Auxiliary Equipment

- Insulators
- Rappers
- Penthouse Purge Air Blowers
- Heaters
- Hoppers
- Hopper Fluidizing Air

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Preparation for Inspection

- **Access**
  - **Special access needed**
  - **Bolted hatches**
  - **Lock out/tag out**
  - **Nuclear level detectors keyed out**

Preparation for Inspection

- **Use of the electrical readings**
  - **Use the meters**
  - **Operation & air load data**
  - **Plan view map of all sections**

Preparation for Inspection

Record Keeping

- Field maps and locations
- Time savers in short outages
- Sections needing specific improvement
- Operations input - Problem areas
- Maintenance input – Problem areas

Preparation for Inspection

Safety Procedures

- Interlocks
- Grounding
- Common sense
- Confined space entry
- Control Room Notification
- Lock out / tag out procedures

Good Inspection Practices

- **Design**
  - **Good access to all areas**
  - **Natural pitfalls or hazards**
- **Personnel selection**
  - **Interested, enthusiastic & thorough**
  - **Buddy or team system**

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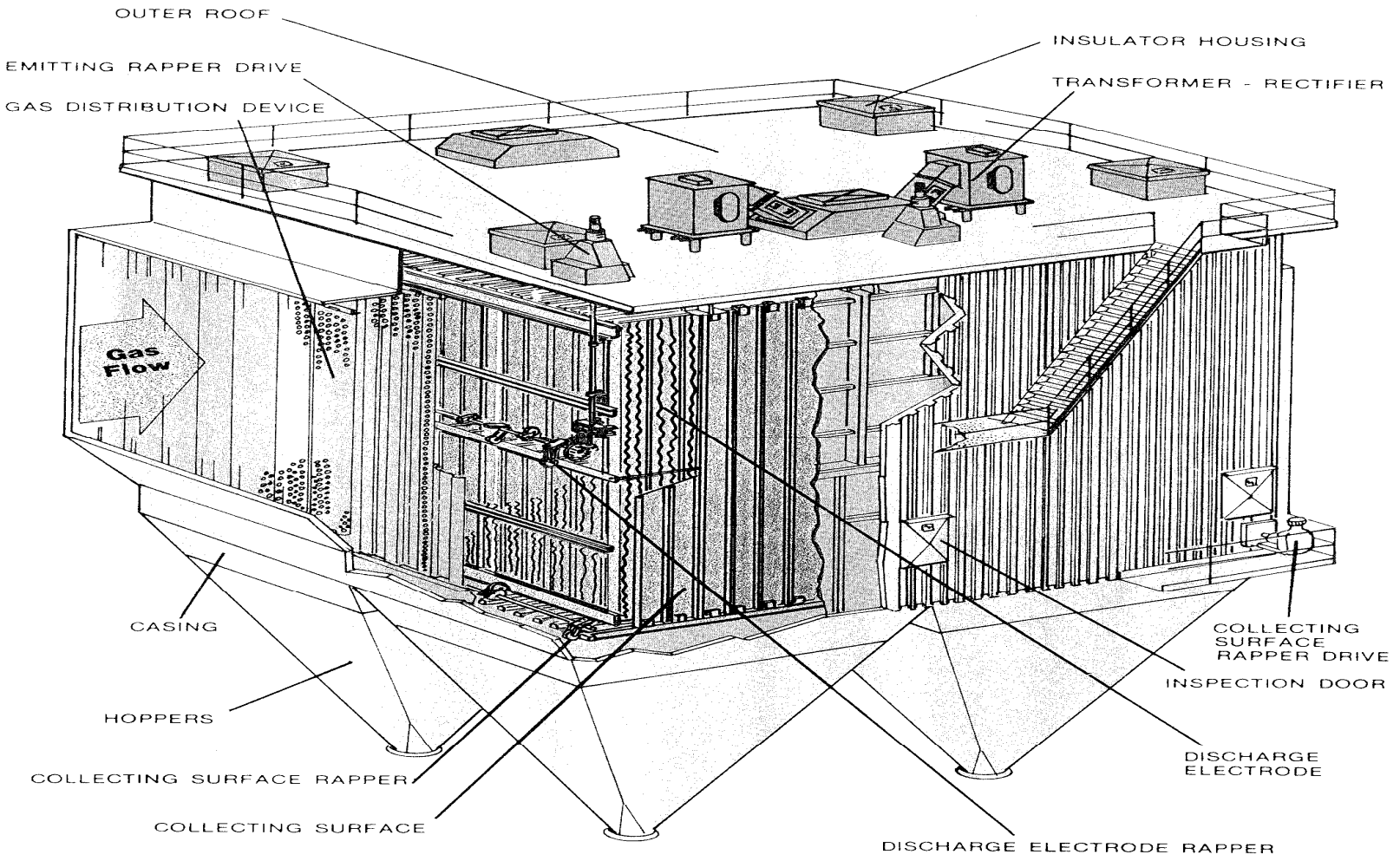
Good Inspection Practices

- **Effects of Large Quantity of Components**
  - **Weakest link limits voltage**
  - **Which link is the cause?**
  - **Periodic note taking**
  - **Bus sections, fields, walkways**

European Type ESP



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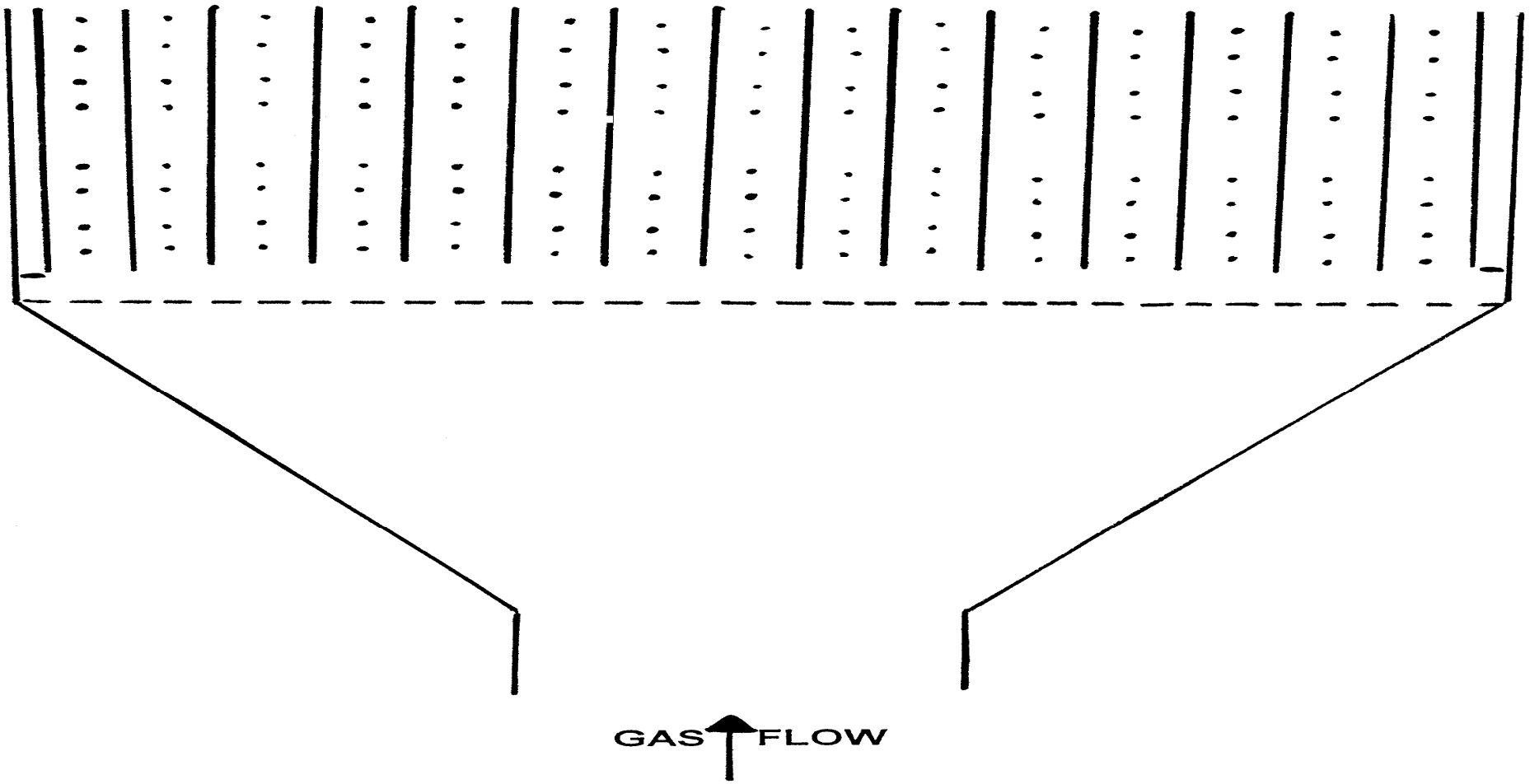
Plan View of an ESP Electrical Field



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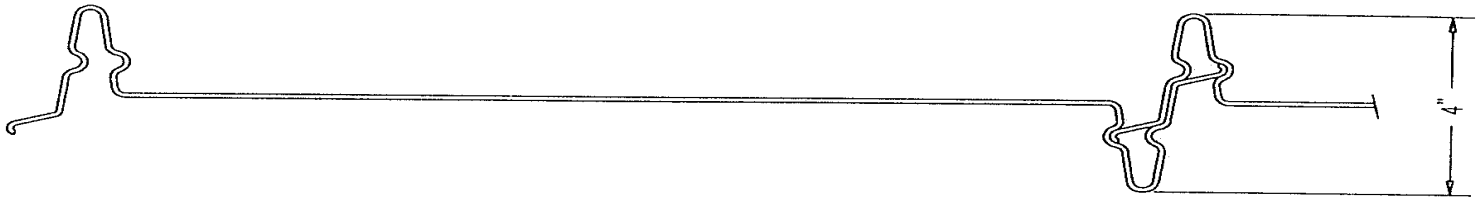
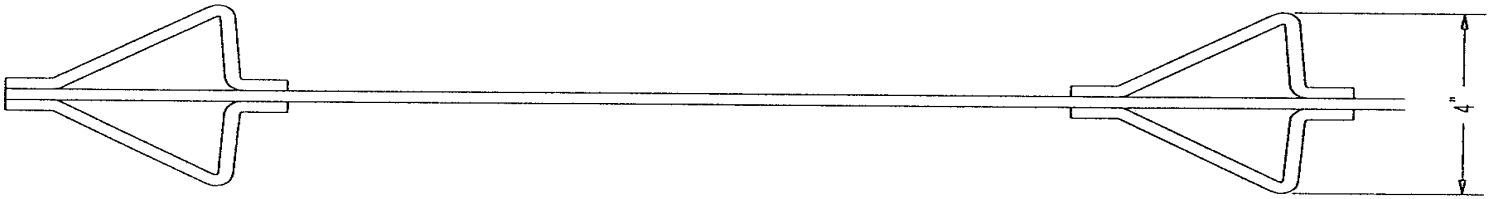
Typical Collecting Plate Designs



TYPICAL MODULOK SECTION

TYPICAL ROLL FORMED SECTION



ESP–1 SECTION

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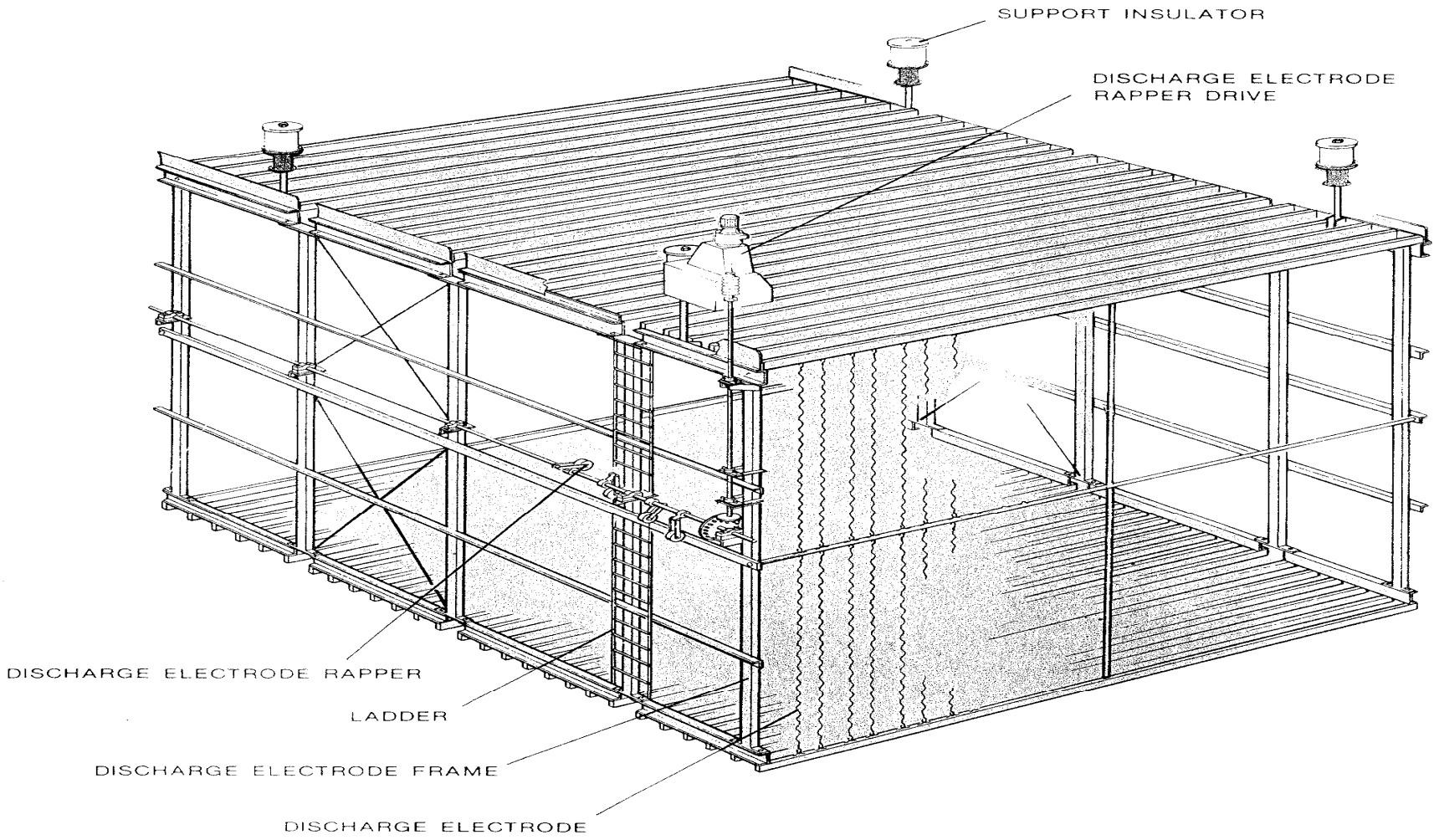
European Rigid Frames



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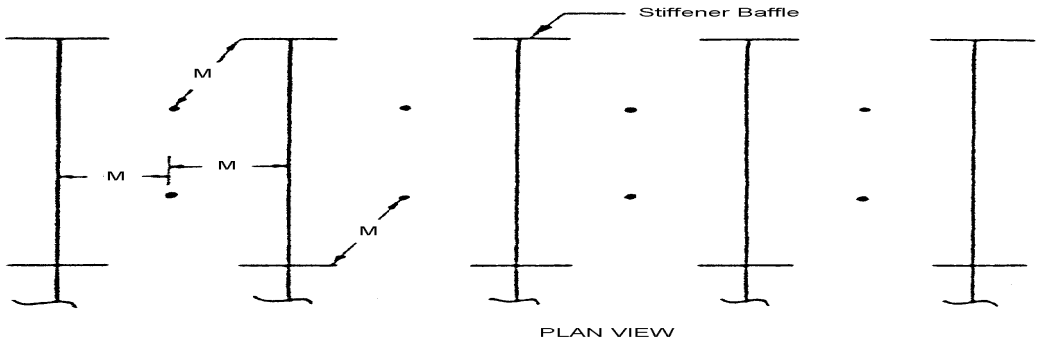
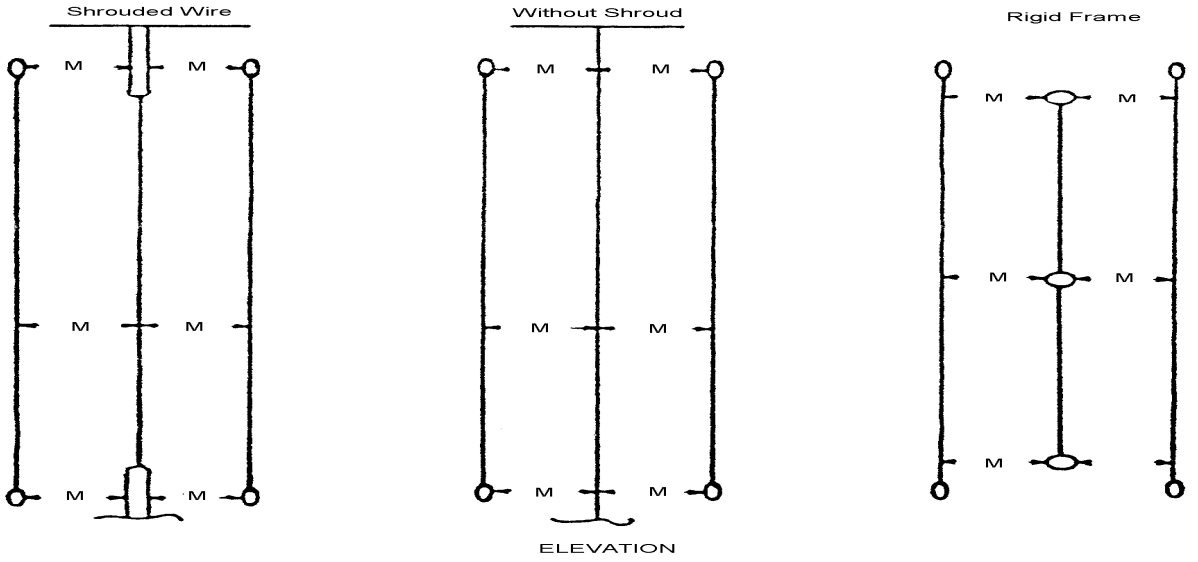
Alignment Measurement Points

Designated by the Letter “M”





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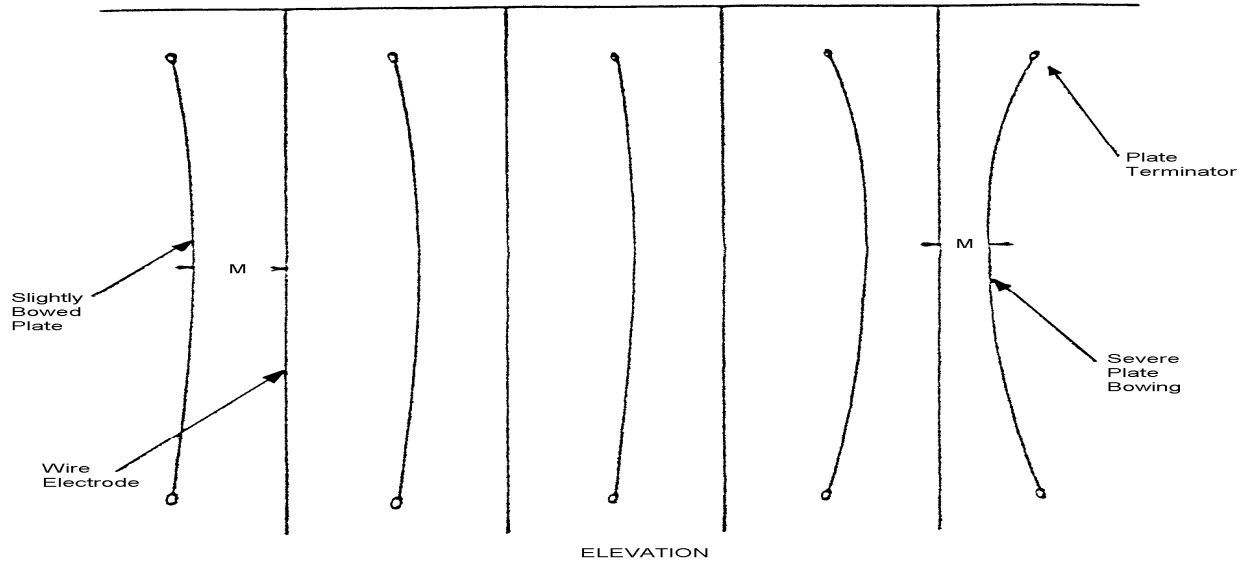
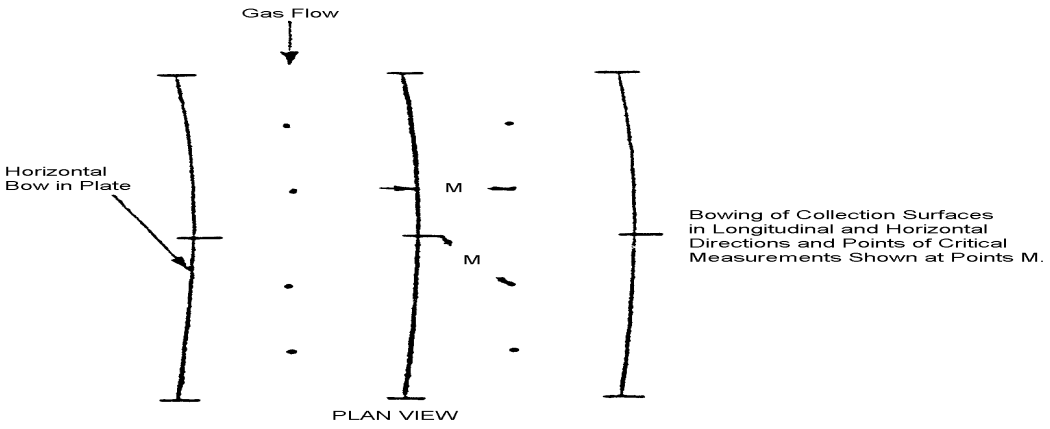
Evaluating Electrode Damage





Bowing of Collection Surfaces in Longitudinal and Horizontal Directions and Points of Critical Measurements Shown at Points M.

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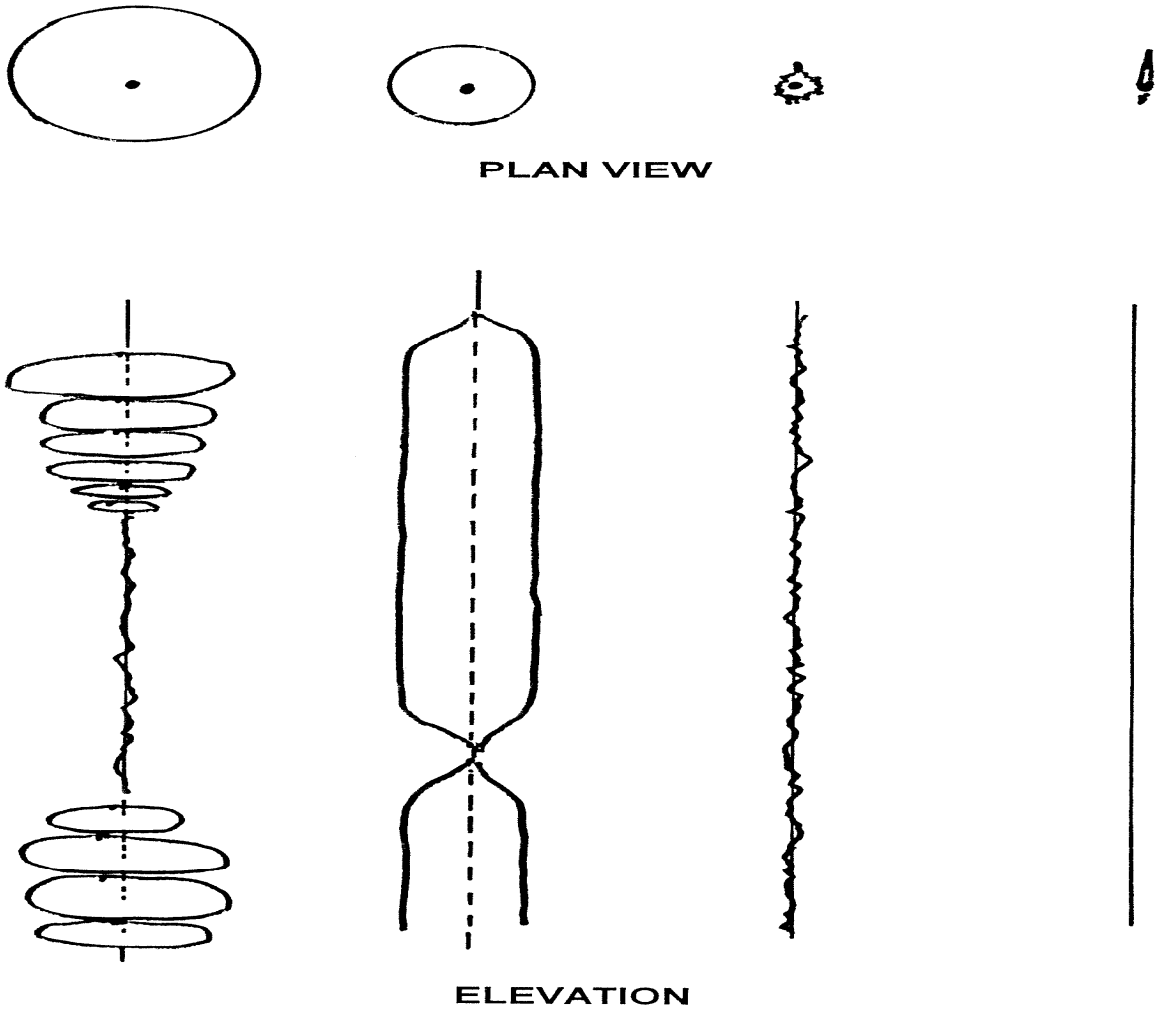
Typical Dust Build-Up



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Major Areas of ESP Breakdown

Area	Most Common Reasons for Failure	Frequency of Failures Goal
Rappers	• Design • Overrapping	1/Year
Insulators	• Lack of Heat • Lack of Purge Air • Mechanical Stress	½ Year
Discharge Electrodes	• Design or Erection • Over Rapping • Corrosion • Misalignment • Insufficient Weights • Full Hoppers	Few After Start-Up 1/Year After
Collector Plates	• Design or Erection • Over Rapping • Corrosion • Excessive Heat • Full Hoppers	-----
Hoppers	• Design • Evacuation Cycle • Lack of Heat • Type of Material • Other	1/Month Maximum

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Standard Inspection Checklist

- Transformer enclosure
- High-voltage bus duct
- Penthouse, rappers, vibrators
- Collecting surface support beam
- Upper discharge electrode pipe frame assembly

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Transformer Enclosure

- HV bus bar, insulators, bushings, and terminals
- Electrical connections
- Broken surge arrestors
- TR low voltage box
- Arcing in switch enclosure
- No air gap in wire to post connection

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High-Voltage Bus Duct

- Corrosion of duct
- Wall and post insulators
- Electrical connections
- Pass through insulators
- Arcing in bus duct
- Arcing at HV output connections

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Penthouse (Roof Girder)

- Ash accumulation
- Support insulator heaters
- Dust in insulator area
- Corrosion in insulator area
- Water inleakage
- HV connections
- HV support insulators

Collecting Surface Support Beam

- Plate and hanger connections
- Ash buildup
- Tears at plate connections
- Hardware condition-deterioration

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Discharge Electrode Pipe Frame Assembly

- Welds between hanger and pipe frame connections
- Discharge pipe frame support bolts
- Support beam welds and connections
- Frame level and alignment to gas stream
- Alignment of pipe frames in/out of gas passage
- Distortion

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Collecting Electrodes

- Dust deposits
  - Location
  - Amount
- Plate alignment
  - Plate plumb
  - Plate warped
- Alignment guides

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Discharge Electrode Assembly

- Dust deposits
  - Location
  - Amount
- Broken wires
- Bowed electrodes
- Wire/electrode alignment
- Wires crossed

Hoppers

- Dust buildup
- Level detectors
- Heaters
- Vibrators
- Dust buildup in corners and walls
- Angle clips-construction pads

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Dust Discharge System

- Valves
- Air Locks
- Conveyors

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General

- Corrosion
- Interlocks
- Ground system
- Turning vanes
- Distribution plates
- Ductwork
- Expansion joints

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WHAT IS LEFT TO DO?

- **Once the “Clean or Dirty” Inspection is complete, you want to energize the precipitator to make sure all the Bus Sections come up and you have know grounds, arcing, etc…**
- **When energizing the precipitator, make sure that people are not in the ductwork as the precipitator will produce ozone and could cause death.**