Online Assessment Techniques

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Electrostatic Precipitator Performance Based on

- Mechanical
- Electrical
- Operational
- Maintenance

Power System Components

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1. Different Parts of power system

Parameters

- Typical parameters that can be monitored include:
  - Voltage/current
  - Opacity
  - Gas temperature
  - Gas flow rate and distribution
  - Gas composition and moisture

Voltage/Current

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- Voltage and current values for each T-R set should be recorded;
- ESPs are equipped with primary voltage and current meters on the low-voltage (AC) side of the transformer
- Secondary voltage and current meters on the high-voltage rectified (DC) side of the transformer.
- When both voltage and current meters are available on the T-R control cabinet, these values can be multiplied to estimate the power input to the ESP.
- Current times Voltage represent the number of watts being drawn by the ESP and is referred to as the corona power input.
- Whenever a short term spark occurs in a field it can be detected and counted by a spark rate meter.
- ESPs generally have spark rate meters to aid in the performance evaluation.

Auto Volt Controller

- The power input on the primary versus the secondary side of the T-R set will differ
- The power input on the primary versus the secondary side of the T-R set will differ because of the circuitry and metering of these values.
- The secondary power outlet (in watts) is always less than the primary power input to the T-R.
- The ratio of the secondary power to the primary power will range from 0.5 to 0.9 and average from 0.70 to 0.75

Meters

- The electrical meters on the T-R cabinets are always fluctuating.
- Normal sparking within the ESP causes these fluctuations in the meter readings.
- These short term movements of the gauges indicate that the automatic voltage controller is restoring the maximum voltage after shutting down for several milliseconds to quench the spark.
- When recording values of the electrical data from the T-R meters it is important to note the maximum value that is sustained for at least a fraction of a second

Electrical

- Voltage and current values for each individual T-R set are useful because they inform the operators how effectively each field is operating.
- Make the trend charts for each field.
- T-R set readings for current, voltage, and sparking rates should follow certain patterns from the Inlet to Outlet fields.
- For example, corona power density should increase from inlet to outlet fields as the particulate matter is removed from the gas stream.

How electrical parameters help

- The air-load and gas-load V-I (voltage-current) are the other tests, which may be conducted on virtually all ESPs.
- Air-load and gas-load curves are graphs of the voltage (kV) versus the current (mA) values obtained at a set condition (test point)
- These curves are developed to evaluate ESP performance by comparing the graphs from inlet field to outlet field and over periods in time.
- Deviation from the normal or previous results can indicate that a problem exists.

Typical AIR-LOAD Curve

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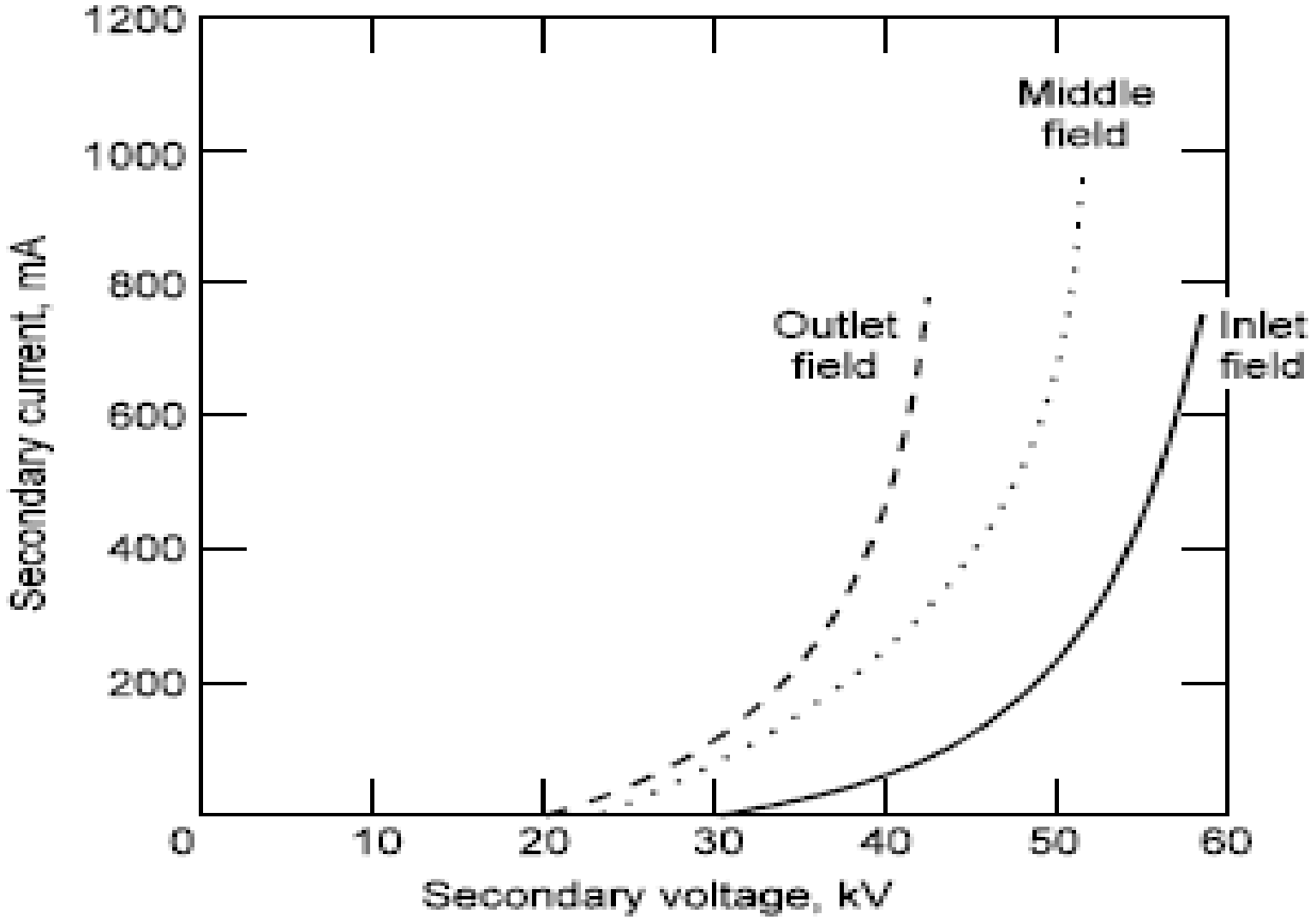

How Air load test is done

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An air-load V-I curve can be generated with readings from either primary or secondary meters.(when the ESP is new, after the first shutdown, and every time off-line maintenance is performed on the ESP)

- The following procedures can be used by the ESP operator to develop an air-load curve.

1. Energize a de-energized T-R set on manual control (but with zero voltage and current), and increase the power to the T-R set manually.

2. At corona initiation the meters should suddenly jump and the voltage and near zero current levels should be recorded. It is sometimes difficult to identify this point precisely, so the lowest practical value should be recorded.

3. After corona initiation is achieved, increase the power at predetermined increments by every 50 or 100 milliamps of secondary current or every 10 volts of AC primary voltage (the increment is discretionary)], and record the values for voltage and current.

Electrostatic precipitator load curve

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4. Continue this procedure until one of the following occurs:

- Sparking
- Current limit is achieved
- Voltage limit is achieved

5. Repeat this procedure for each T-R set

When the air-load tests have been completed for each field, plot each field's voltage/current curves.

➢ When ESPs are equipped with identical fields throughout, the curves for each field should be nearly identical.

➢ In most cases, the curves also should be similar to those generated when the unit was new, but shifted slightly to the right due to residual dust on the wires (or rigid frames) and plates of older units.

- These curves should become part of the permanent record of the ESP.

Gas-Load Curves

The gas-load V-I curve, on the other hand, is generated during the normal operation of the process while the ESP is energized.

- **The procedure for generating the gas-load V-I curve is**

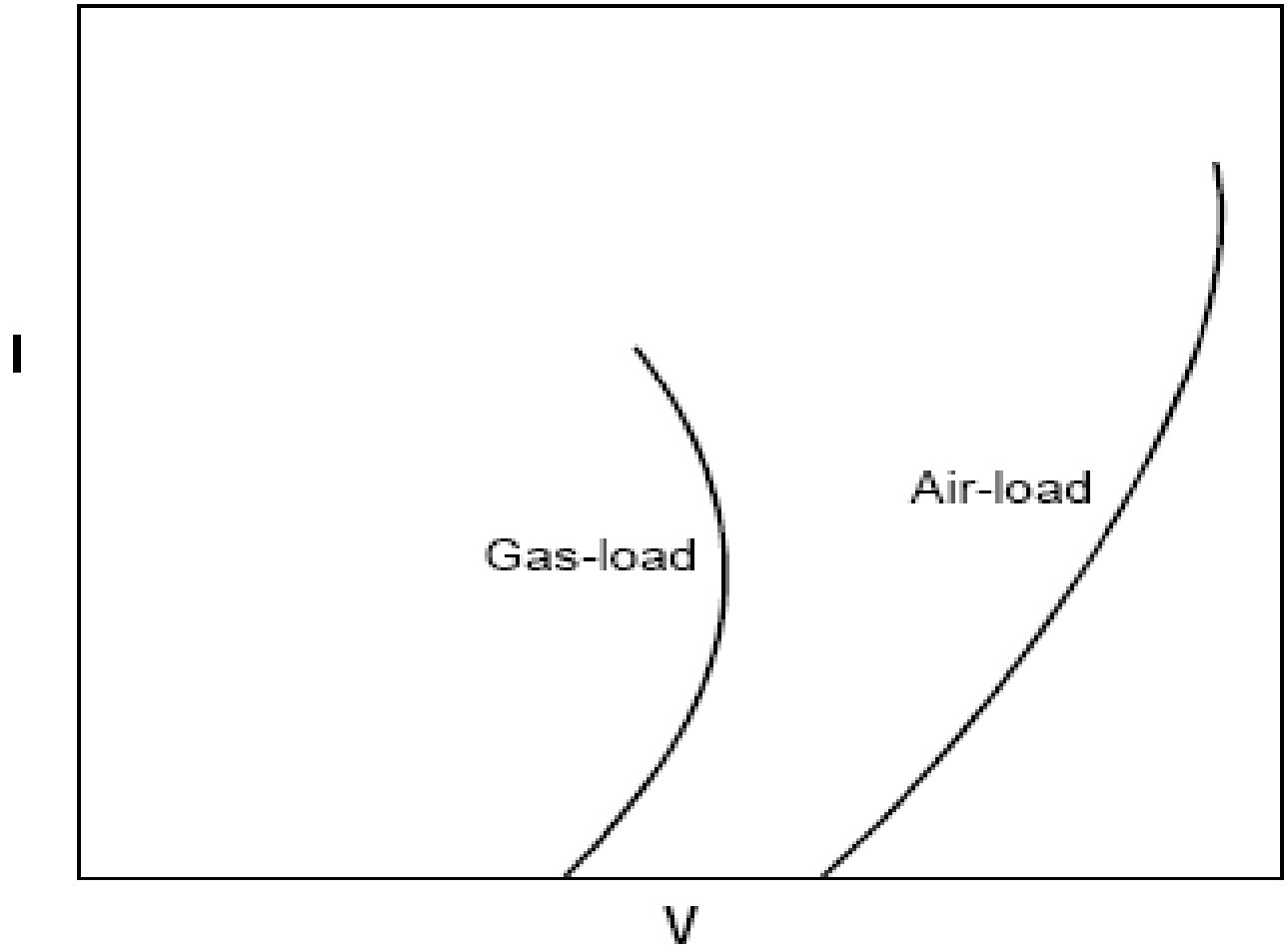
the same as for the air load except that gas-load V-I curves are always generated from the outlet fields first and move toward the inlet.

- **This prevents the upstream flow that is being checked from disturbing the V-I curve of the downstream field readings.**
- **Although such disturbances would be short-lived (usually 2 minutes, but sometimes lasting up to 20 minutes), working from outlet to inlet speeds up the process.**

Gas–Load Curve

- The curves generated under gas-load conditions will be similar to air-load curves.
- Gas load curves will generally be shifted to the left however, because sparking occurs at lower
- voltage and current when particles are present. The shape of the curve will be different for each field depending on the presence of particulate matter in the gas stream.

Gas –Load & Air-Load curve



Daily monitoring

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Also, gas-load curves vary from day to day, even minute to minute. Curve positions may change as a result of fluctuations in the following:

- **Amount of dust on plates**
- **Gas flow**
- **Particulate chemistry loading**
- **Temperature**
- **Resistivity**

➢ **Nonetheless, they still should maintain a characteristic pattern.**

➢ **Gas-load curves are normally used to isolate the cause of a suspected problem rather than being used on a day-today basis; however, they can be used daily if necessary.**

Why ESP Rapper Control essential

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Rappers

Both over rapping and under rapping will deter from optimal performance of the electrostatic precipitator.

- Loss of rapper operation will result in poor precipitator performance.
- Maintain operation of the rappers.
- Always check (on a daily basis) that the rappers are operating.
- Simply walk up on the roof of the ESP and listen to the rappers hitting.
- Over rapping will cause re-entrainment resulting in poor ESP performance and high stack emissions.
- Under rapping will cause an excessive amount of build-up on the collecting plates and discharge electrodes, which will reduce electrical power in the ESP thus resulting in poor ESP performance and high stack emissions.

Importance of maintaining rapper ground straps (Earthing)

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- The complete grounding of the rapper coil assembly and housing is essential to complete the entire grounding of the Electrostatic Precipitator.

- The shaft connections on the rappers are usually not sufficient to assure a complete ground to the rapper coils.

- Transient voltages can occur in the ESP and if the rappers are not properly grounded, these voltages can induce electrical surges into control and power cables, which may damage the controls.

Boot seal

- This is especially true with the high voltage discharge electrode rappers. These rappers are isolated by a shaft insulator.
- Any leakage through this insulator will bleed through to the rapper coil and it is obvious that a good ground connection is required to make sure that any transient voltage is grounded.
- During an ESP walk down, always make sure that the rapper ground straps are securely in place. These ground straps frequently break due to the impact of the rappers.
- Rapper boot seals are important to insure that no rain or cold air is allowed to enter the ESP.
- If the rapper boot seals are leaking, this will allow cold outside air to enter the ESP and create corrosion and possibly damage to the insulators.
- Always make sure that the rapper boot seals are in good condition and that the clamps are tight.
- Replace any boot seals that are torn or cracked. A small item such as a torn boot seal could cause a considerable amount of damage to an ESP.

Rapper, Earthing, Boot seal