

# Reinhold Environmental Ltd.



2008 APC Round Table  
& Expo Presentation

*July 13-15, 2008, in Savannah, GA*

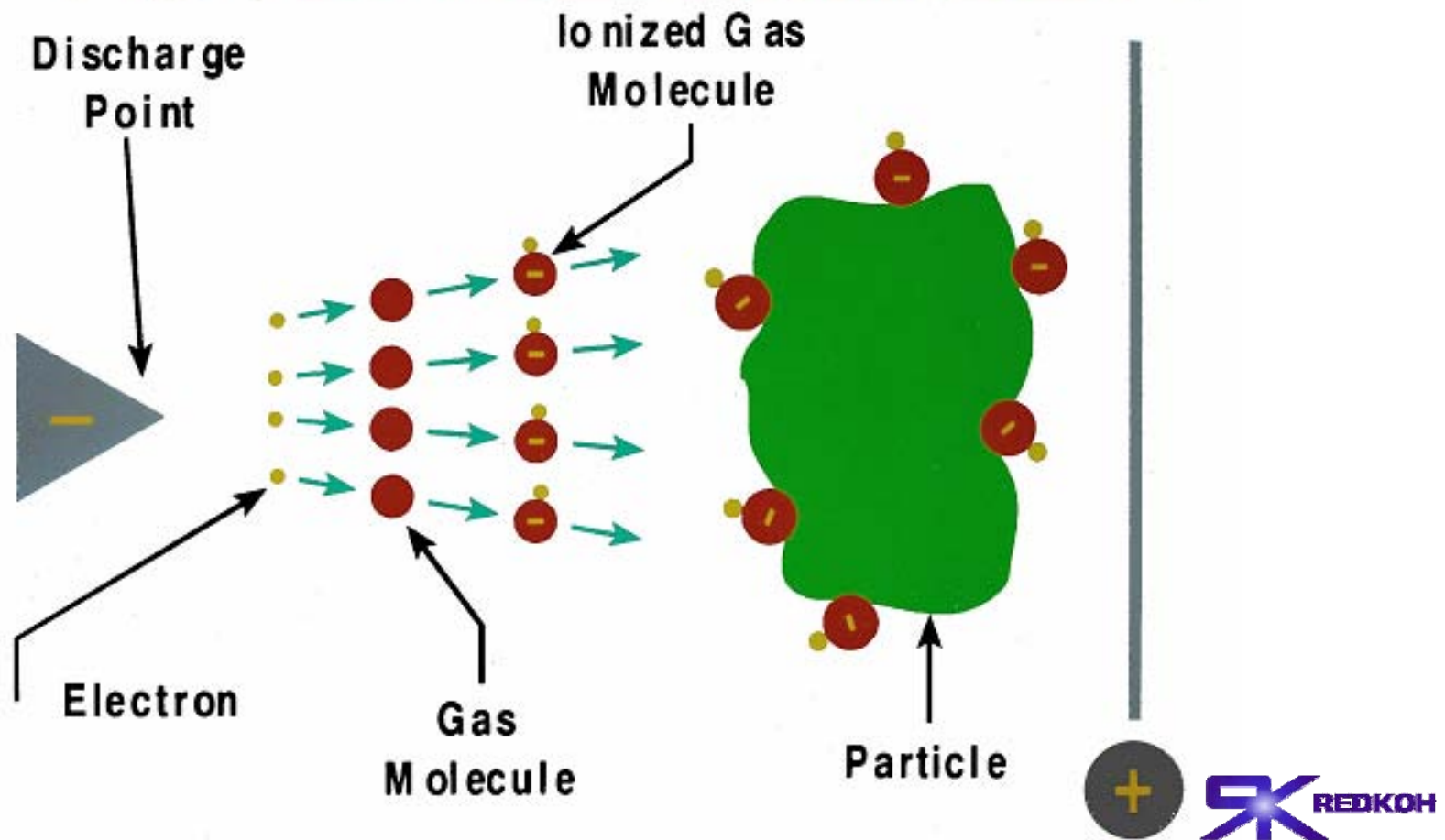


# An Introduction to Precipitator Controls Systems

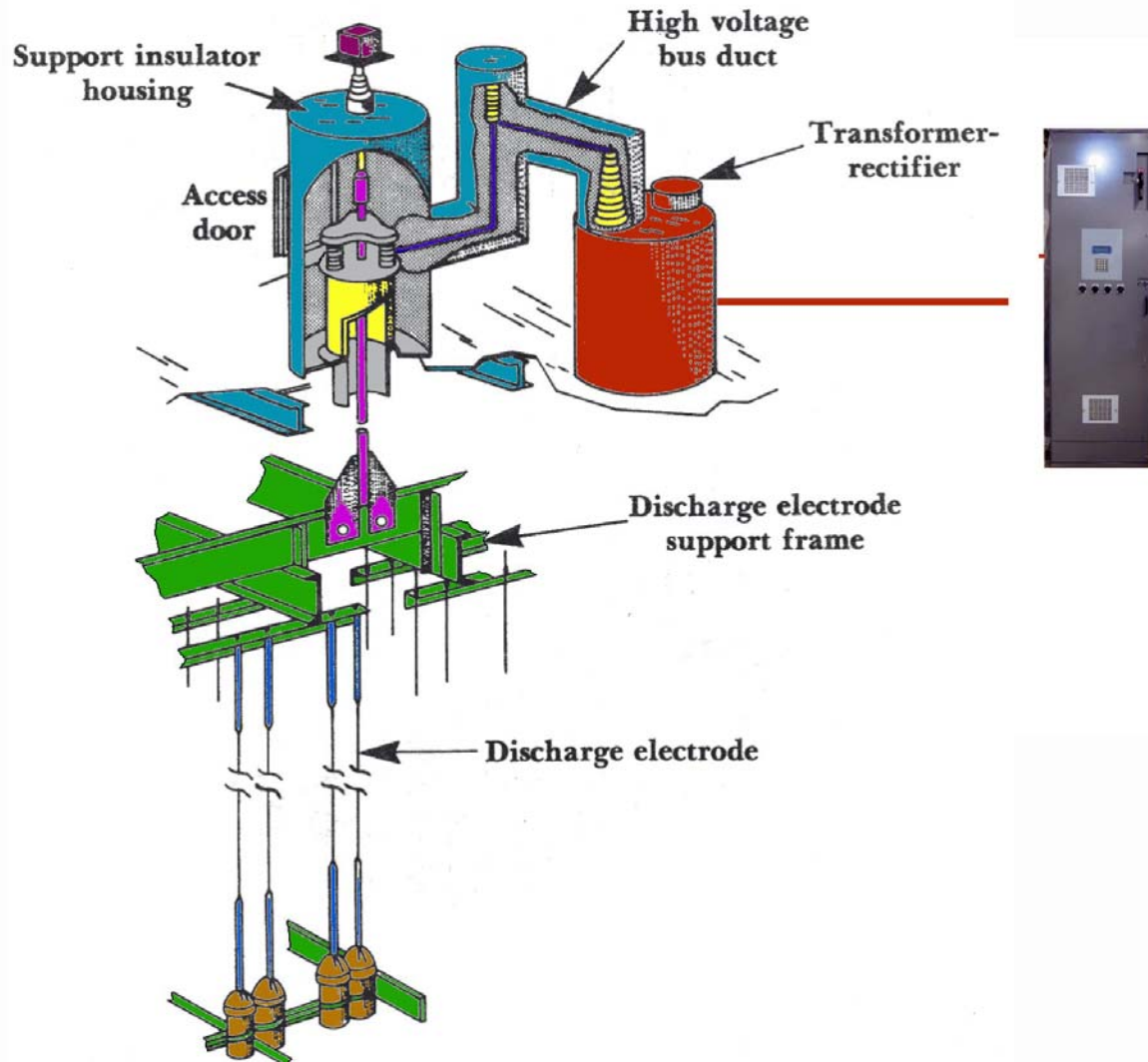
- The aim of this presentation is to:
  - Identify the global requirement of an ESP Control System
  - Identify and discuss an Energization system
  - Build a circuit that discusses the function of each of the components required
  - Put the circuit into the precipitation application – and discuss some of the different techniques available

# How an ESP Does its Magic

## PARTICLE CHARGING

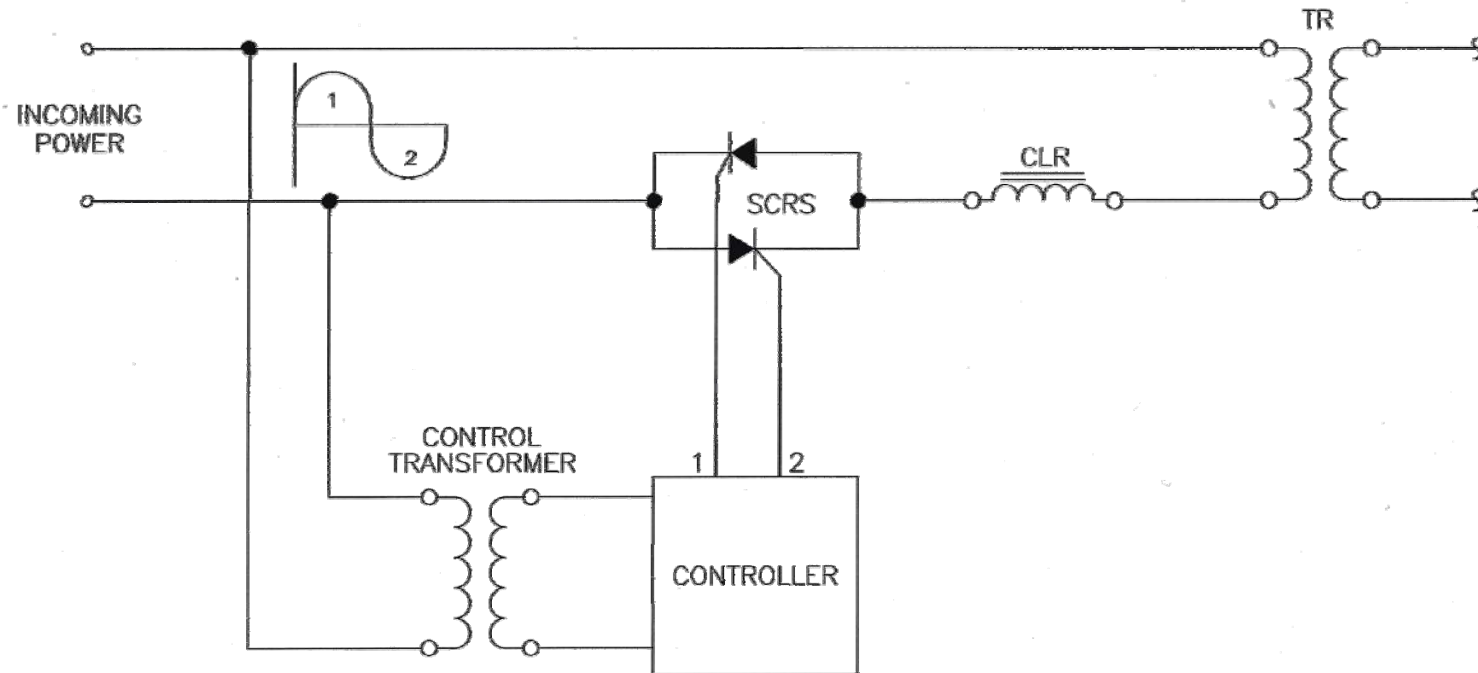


# Where Does the High Voltage Come From?



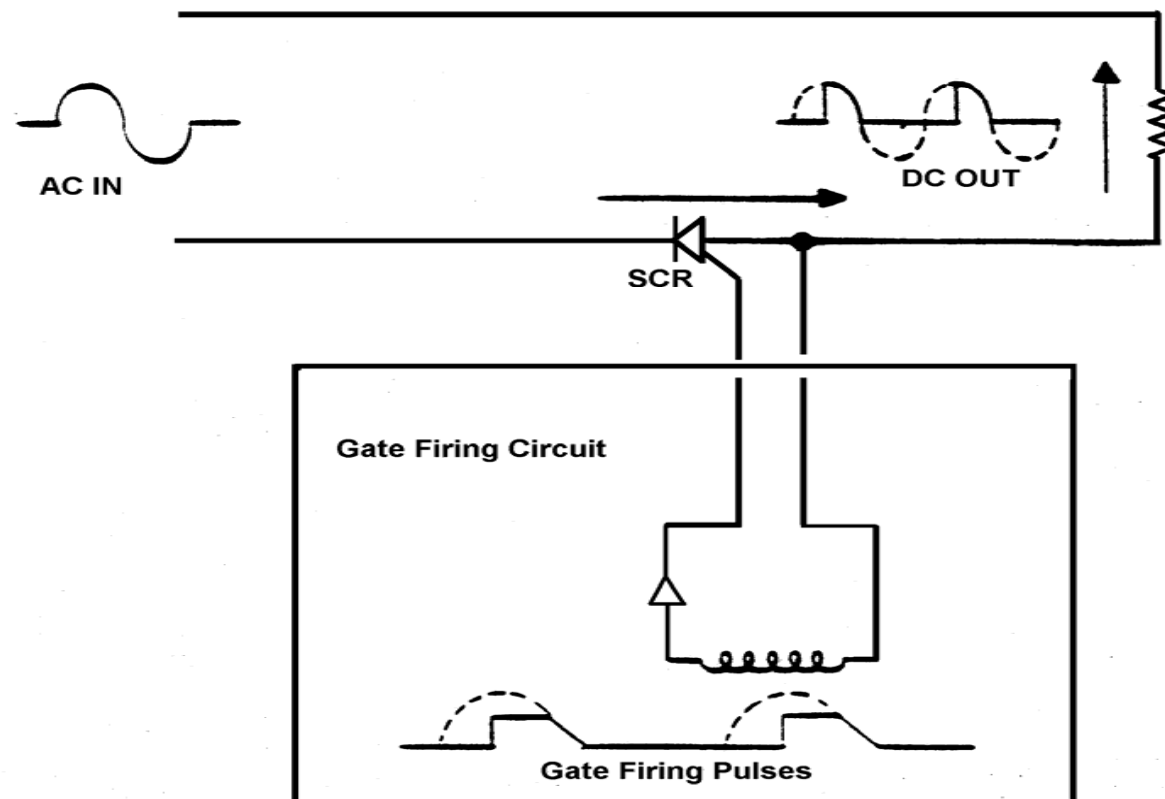


# Basic Schematic



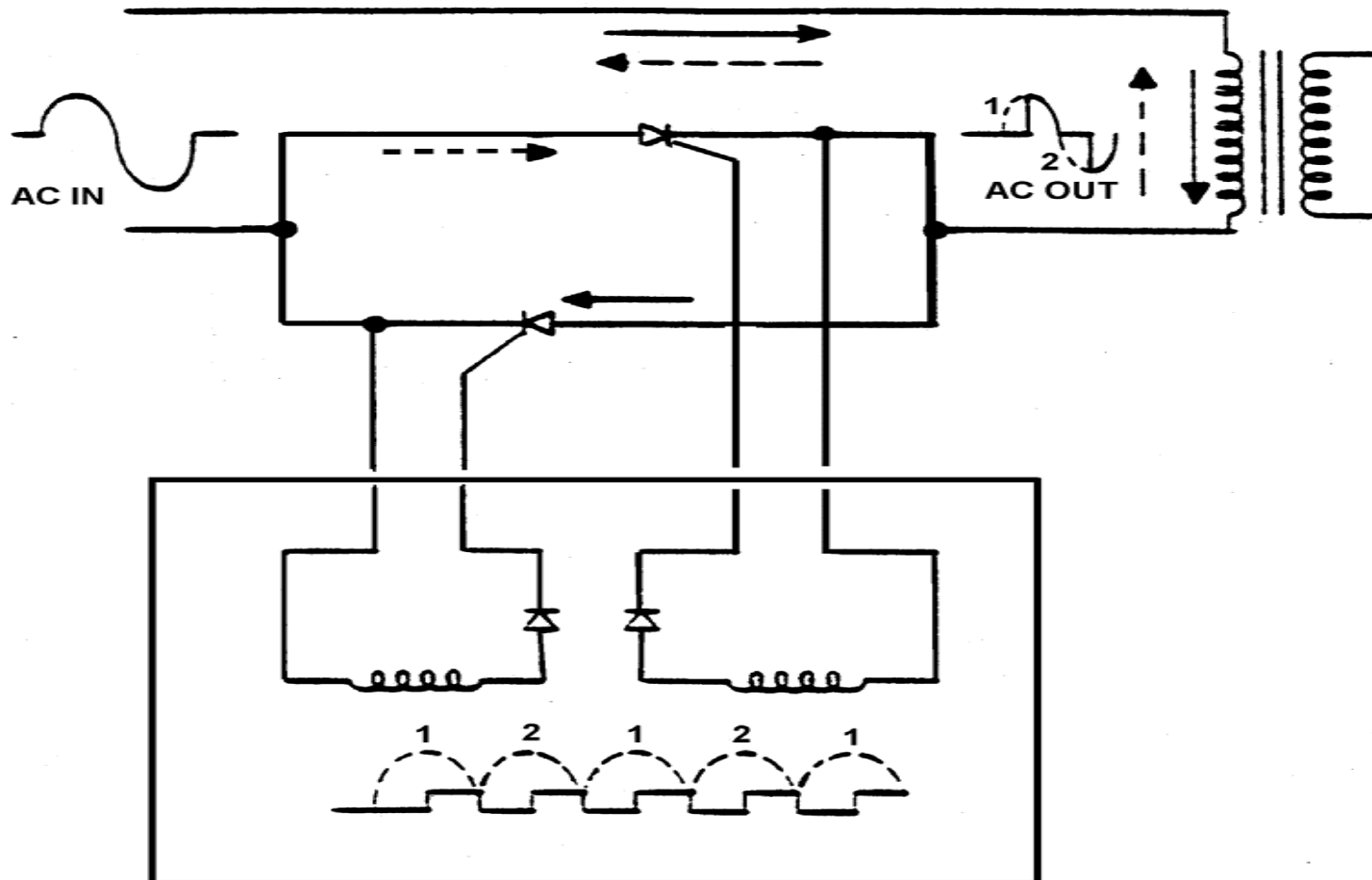


# Single SCR Operation



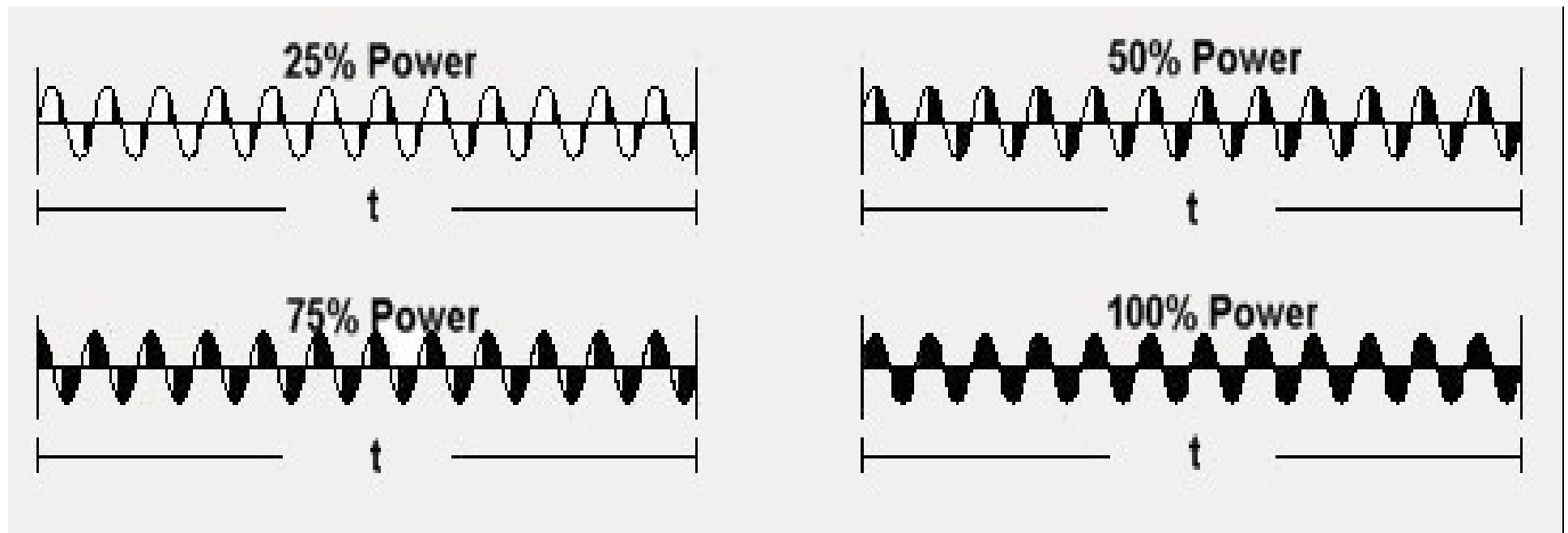


# Inverse Parallel SCR Operation





# Inverse Parallel SCR Operation



## Puck and Stud SCRs



## Module Style SCRs

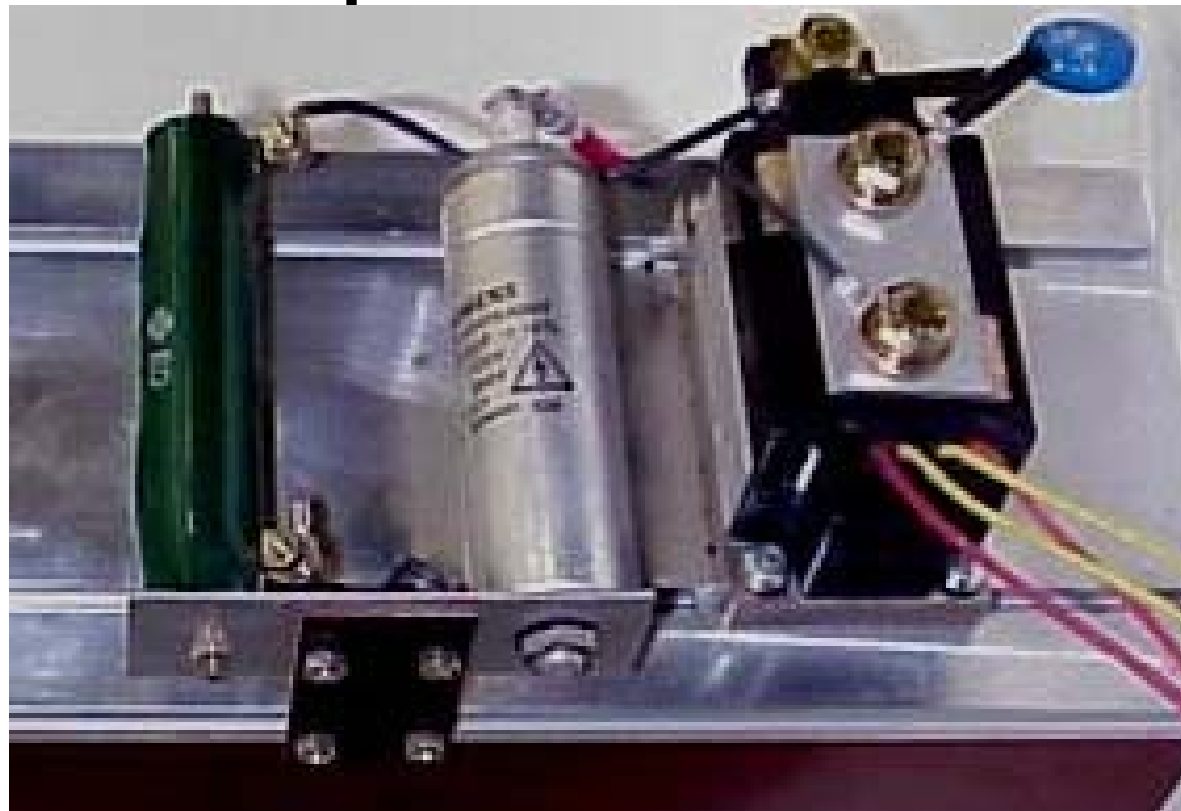


## IGBTs





# The Snubber at it's importance

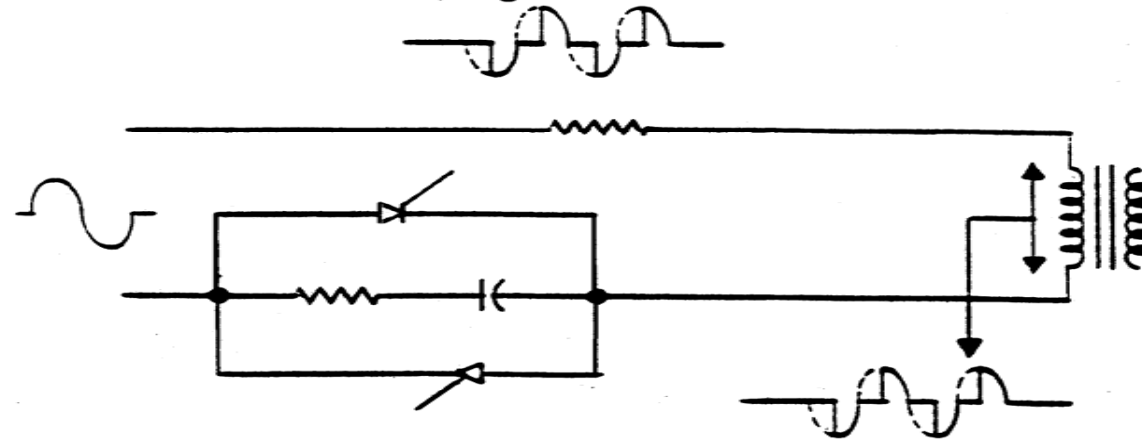


Redkoh Industries - Electrostatic Precipitator Controls Specialists

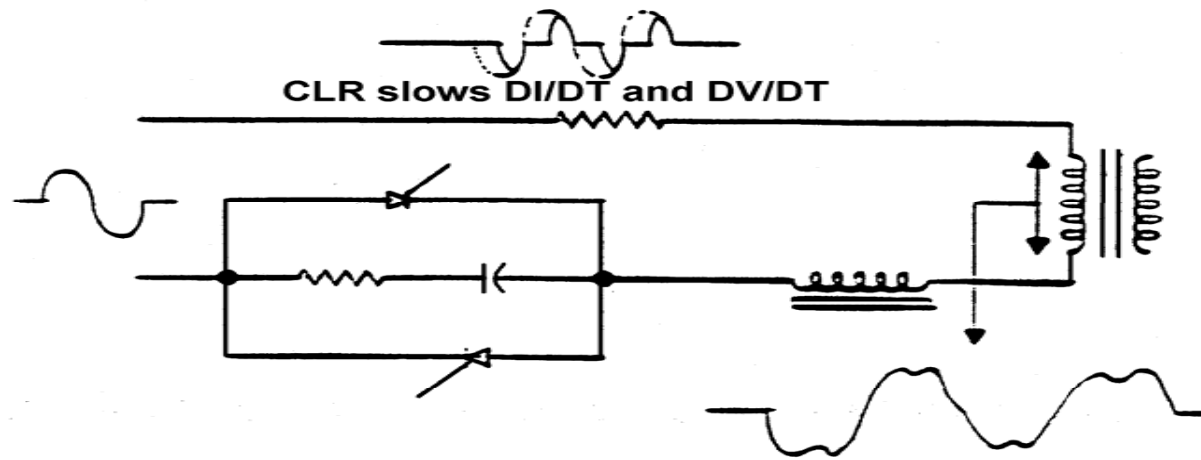


# Addition of CLR

No CLR, high  $DI/DT$  and  $DV/DT$

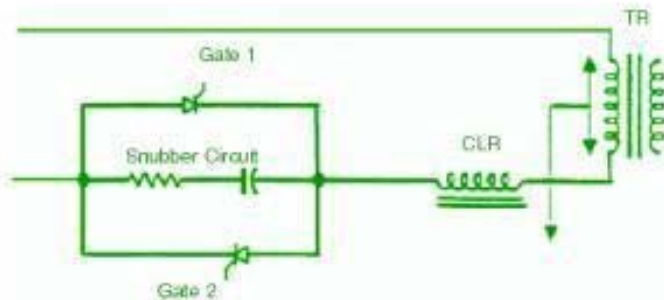


CLR slows  $DI/DT$  and  $DV/DT$



# CLR

## Current Limiting Reactor



Current Limiting Reactor

Time	Primary Volts	Primary Amps	Secondary Voltage (KV)	Secondary Current (ma)	Conduction Angle (degrees)
1	399	238	45	1500	155
2	395	236	44	1507	158
3	392	234	43	1500	162
4	382	228	42	1460	162
5	376	224	41	1430	162
6	362	215	40	1367	162
7	358	213	39	1350	162
8	338	202	37	1274	162

Electrical readings that indicate a CLR failure

Size a reactor

Spot a failing reactor

Failure modes

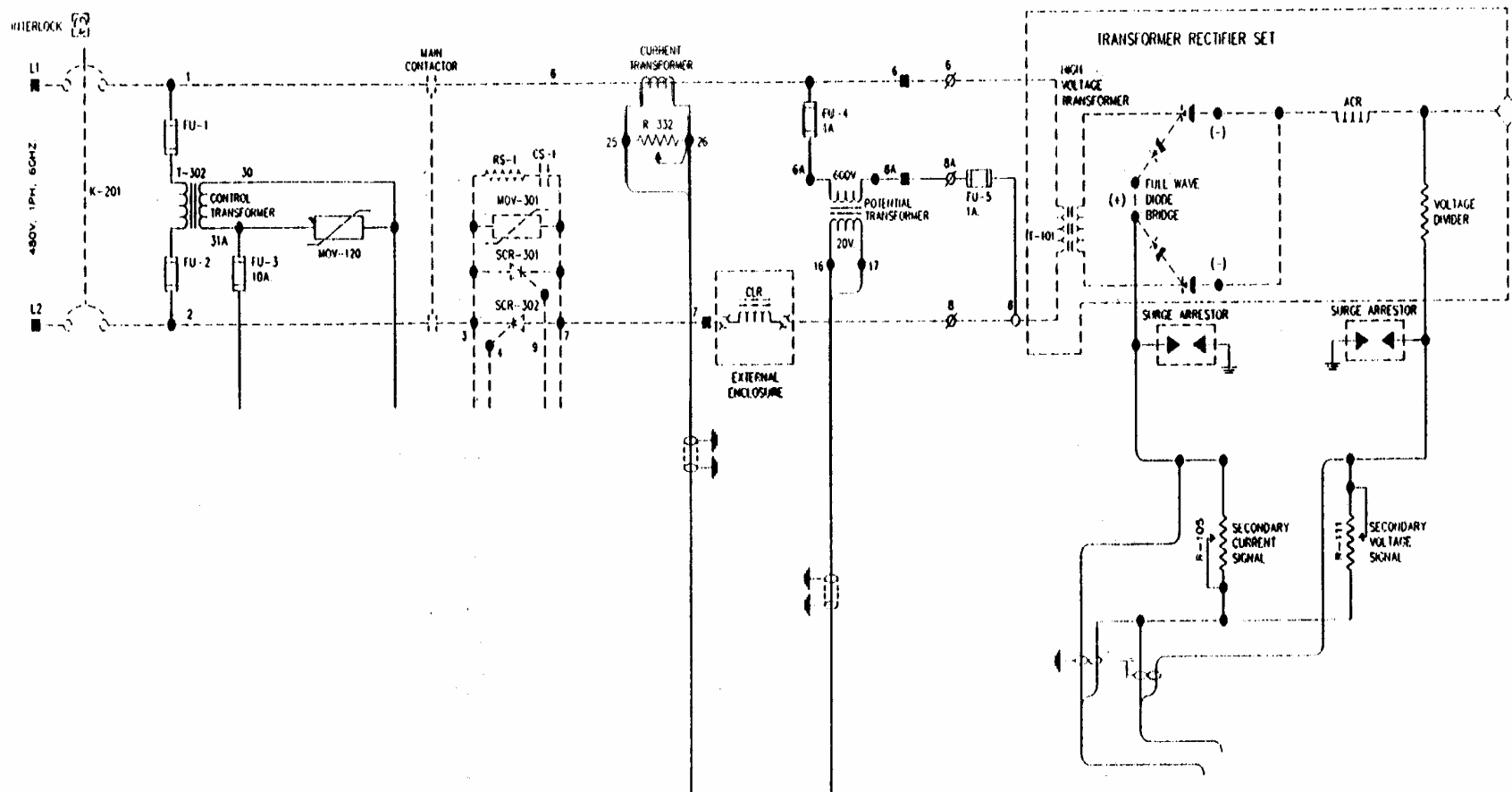


# What are the feedback signals

- These are the signals from which the control system makes all its decisions
  - Primary Voltage - The voltage that appears across the transformer rectifier primary winding
  - Primary Current - The current that is drawn from the supply
  - Secondary Current - The current drawn by the ESP
  - Secondary Voltage - The voltage that appears on the ESP

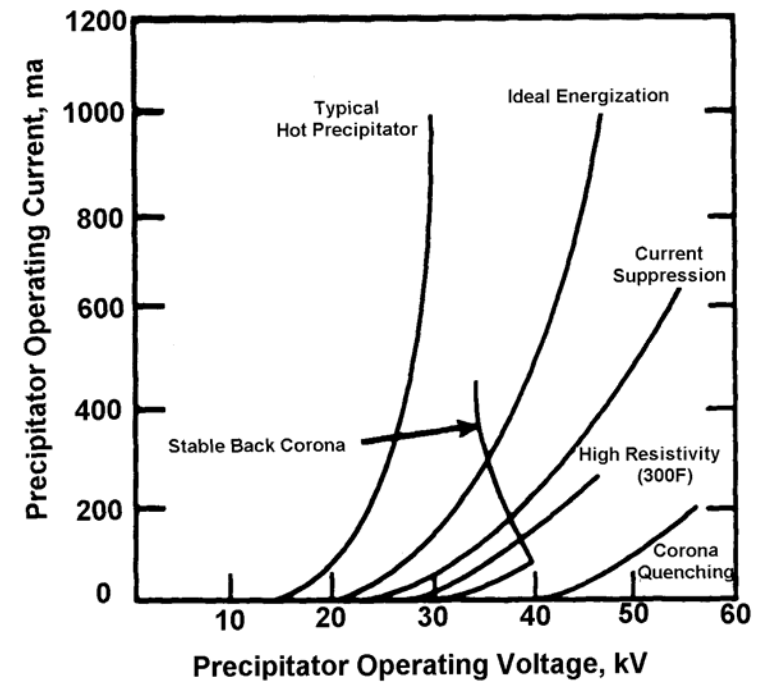
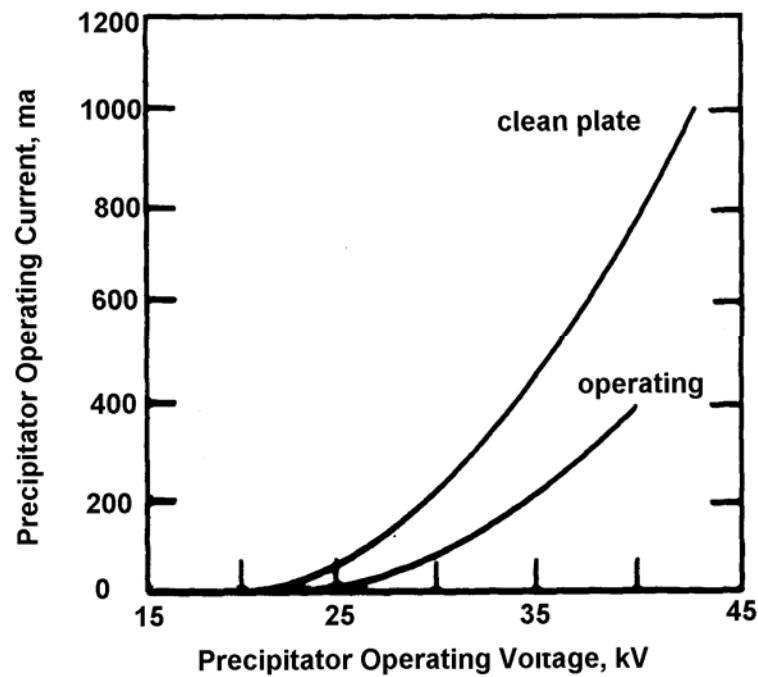


# Schematic with Feedback





# VI Curves





# In Summary

- We have:
  - Identified the global requirement of an ESP Control System
  - Identified and discussed an Energization system
  - Built a circuit that discusses the function of each of the components required

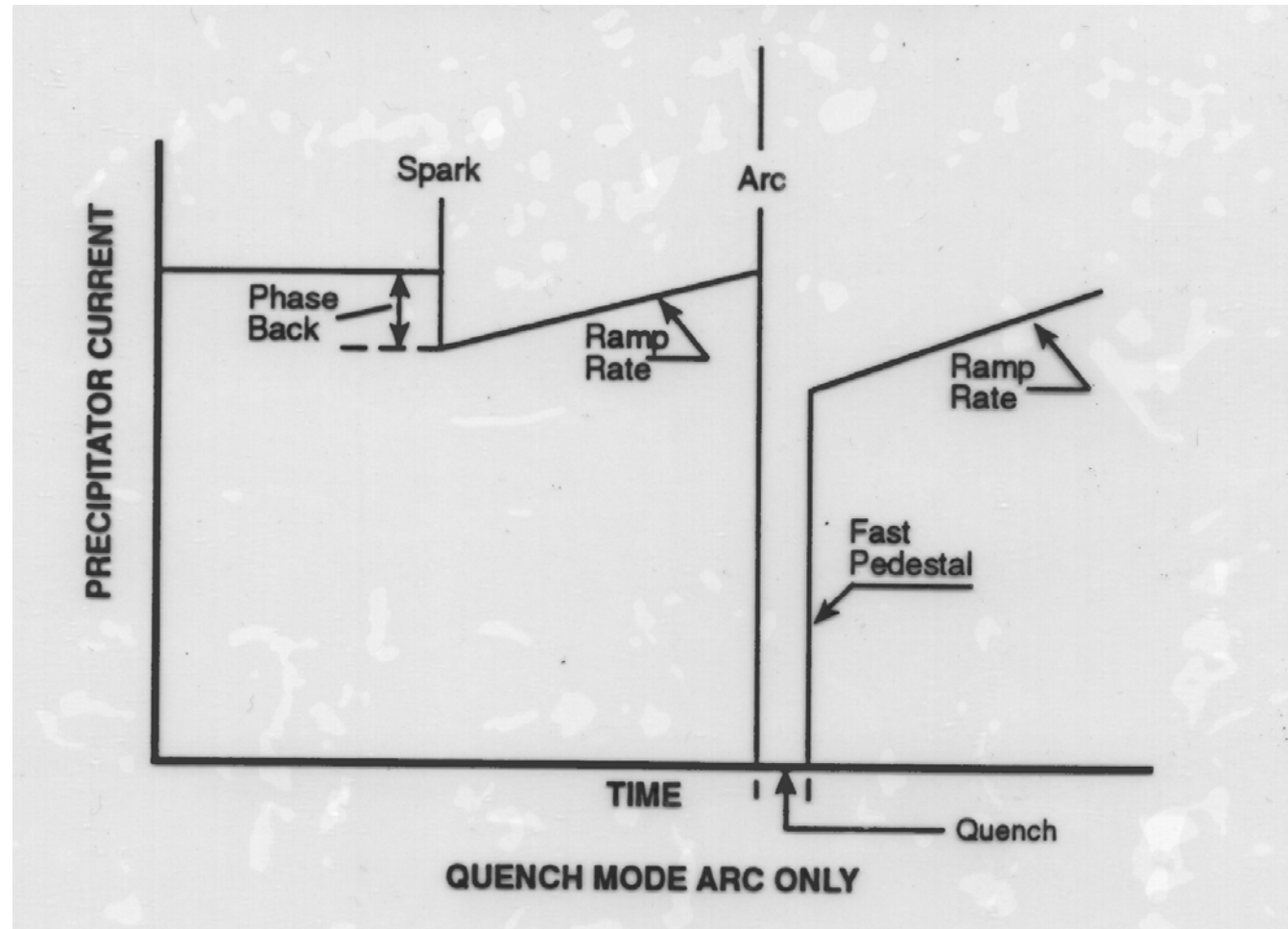


# An Introduction to Precipitator Controls Systems – Part 2

- In this part, we:
  - Put the circuit into the precipitation application – and discuss some of the different techniques available



# Typical Control Waveforms





# What is a spark

A Precipitator disturbance which causes a depression of the electrode voltage for not more than one half cycle of the supply

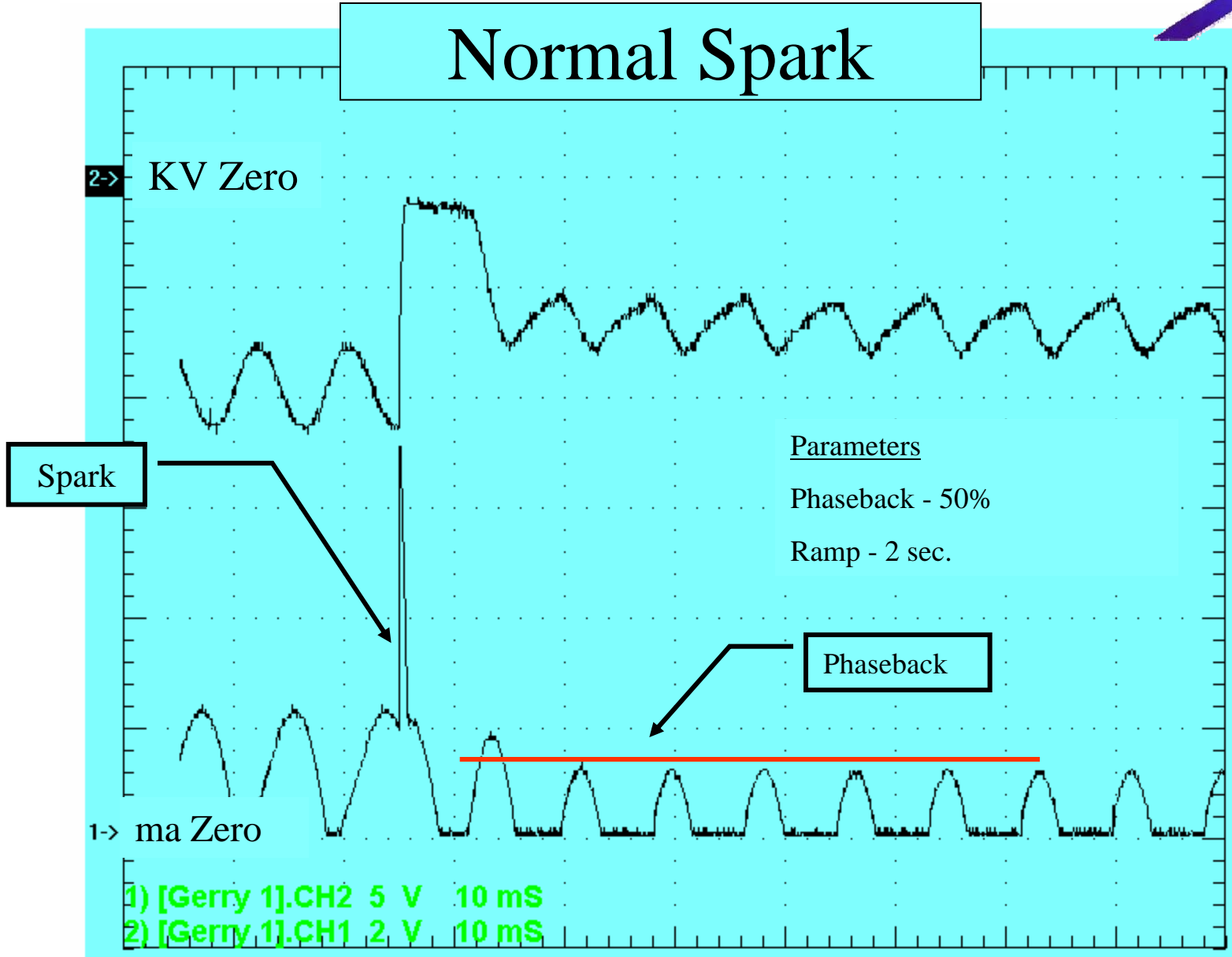


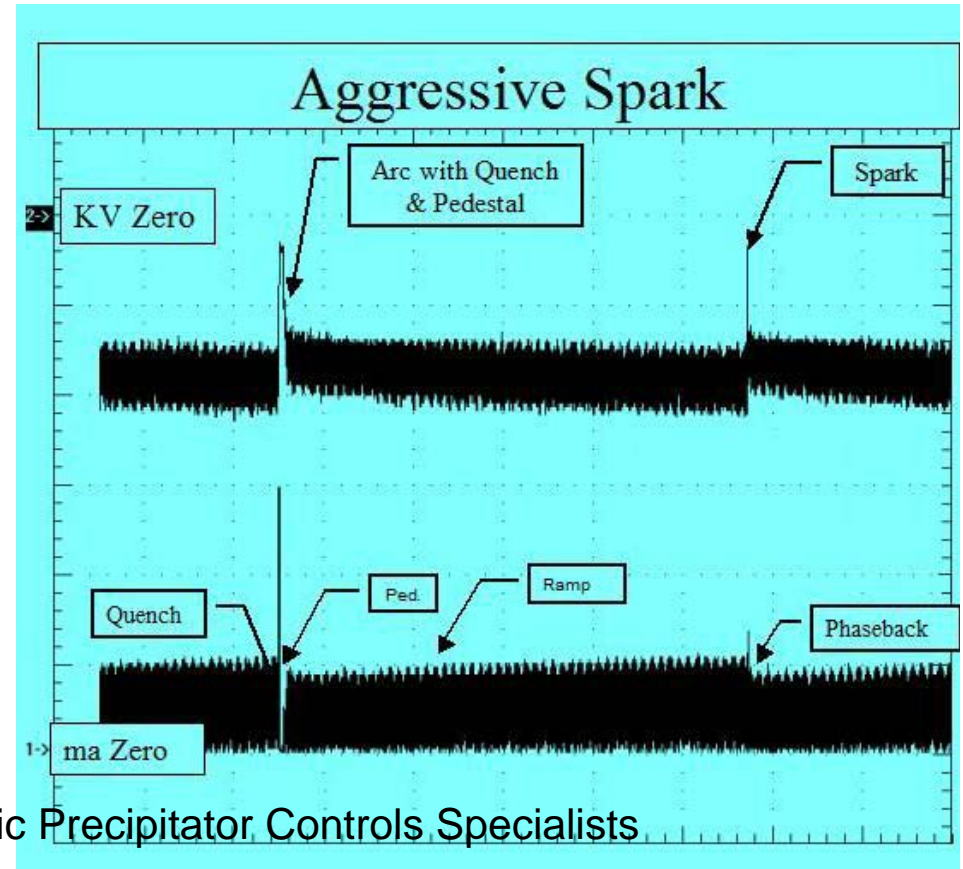
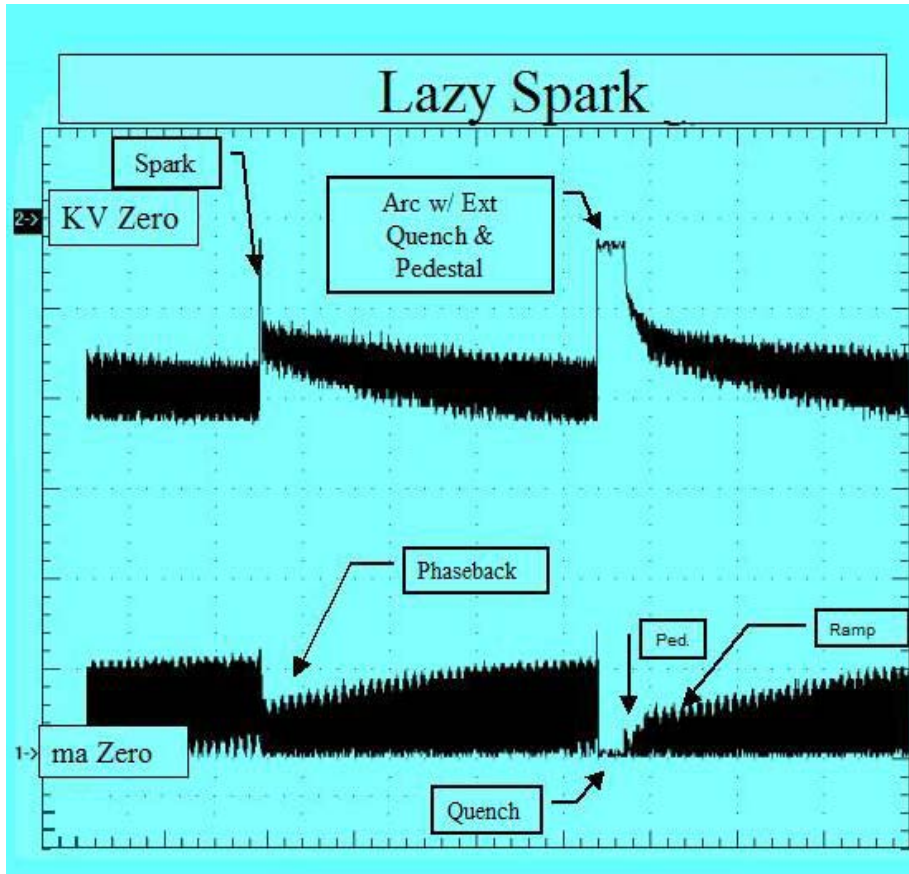
# Spark Detection

- Sparks can be detected by a number of different methods and these include:
  - Looking for transients on the secondary current signal
  - Looking for substantial and instantaneous rises in the primary and secondary currents
  - Looking for sharp falling edges on secondary voltage signals.



# Normal Spark



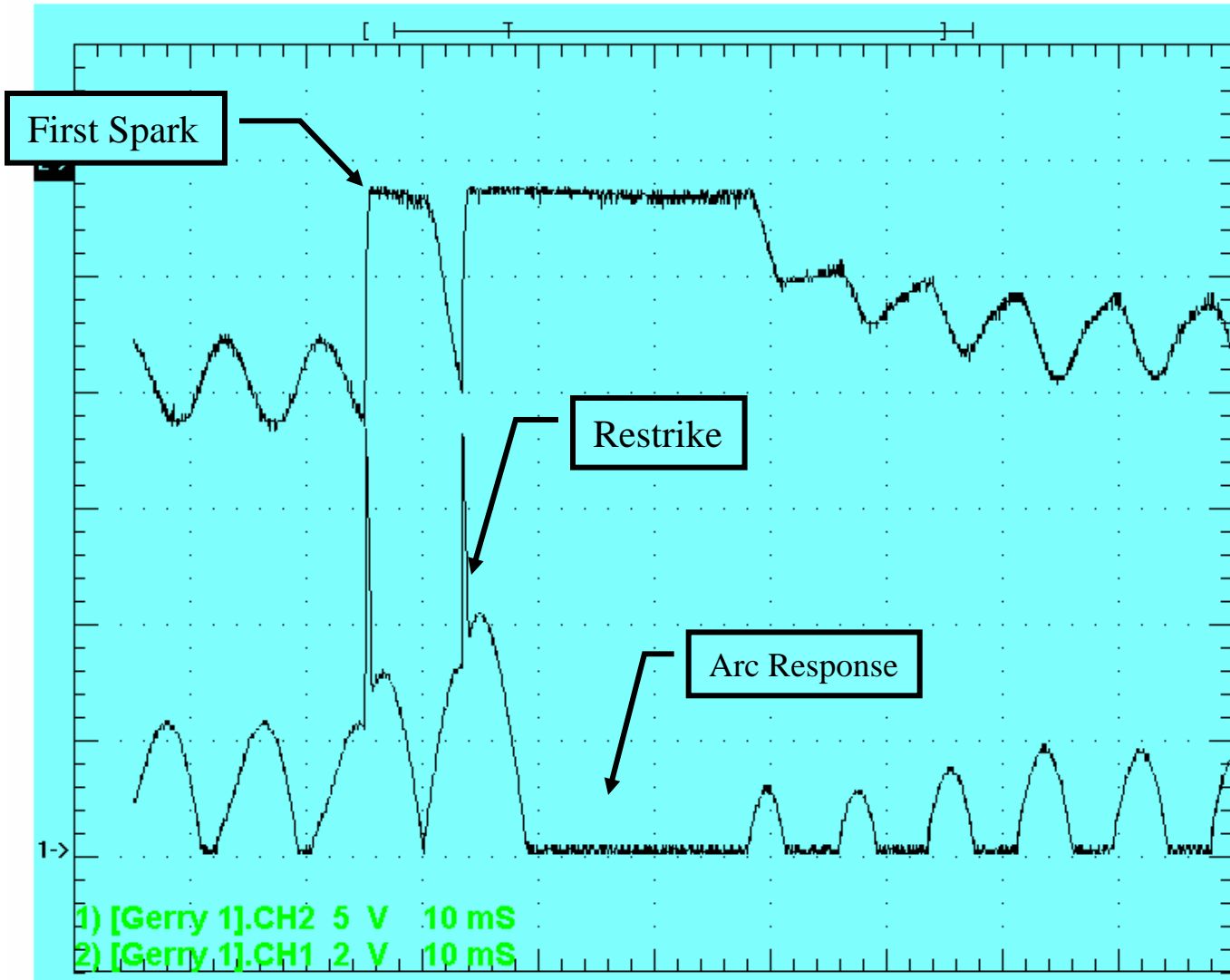


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# What is an Arc

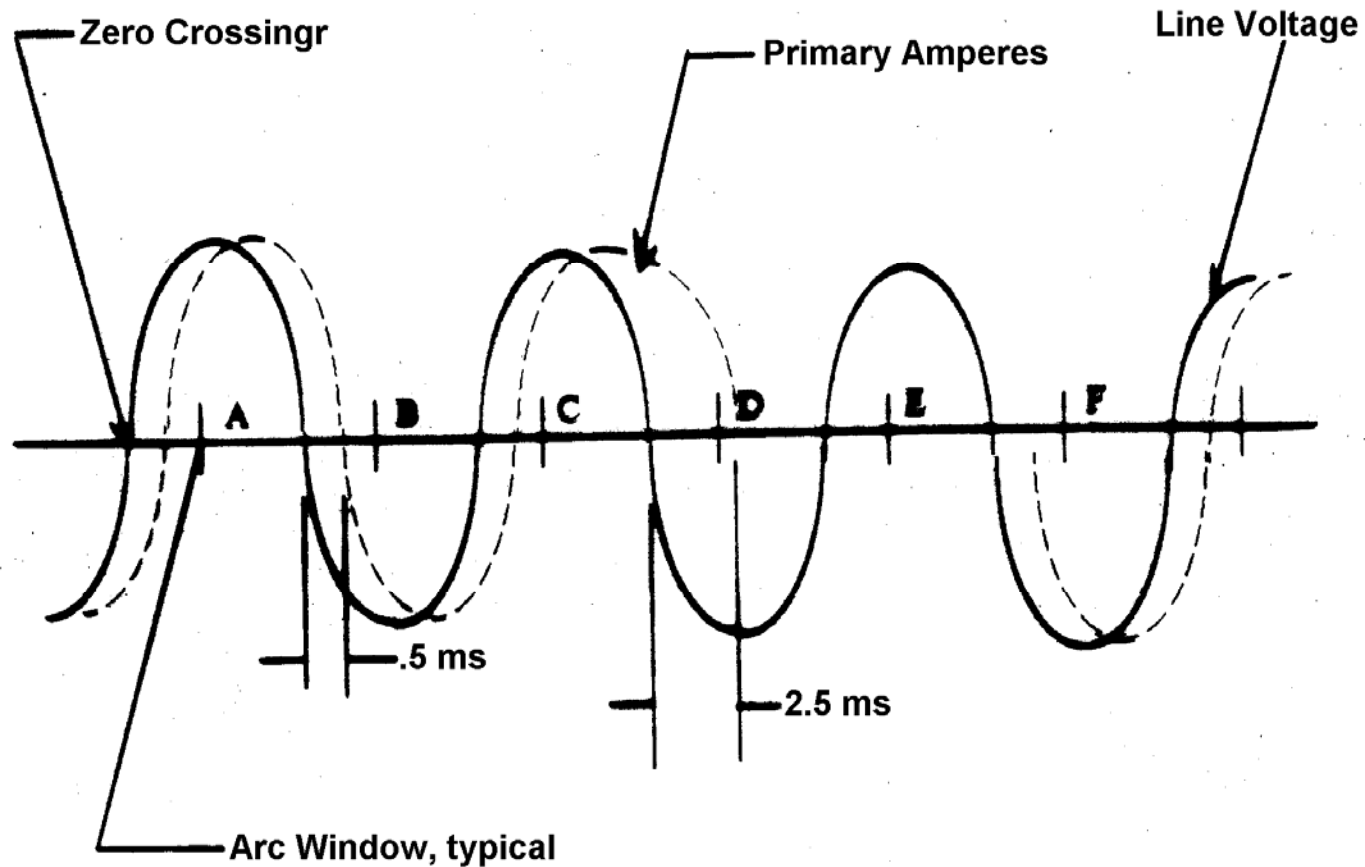


A Precipitator disturbance which causes successive or a continued depression of the electrode voltage





# Arc Detection

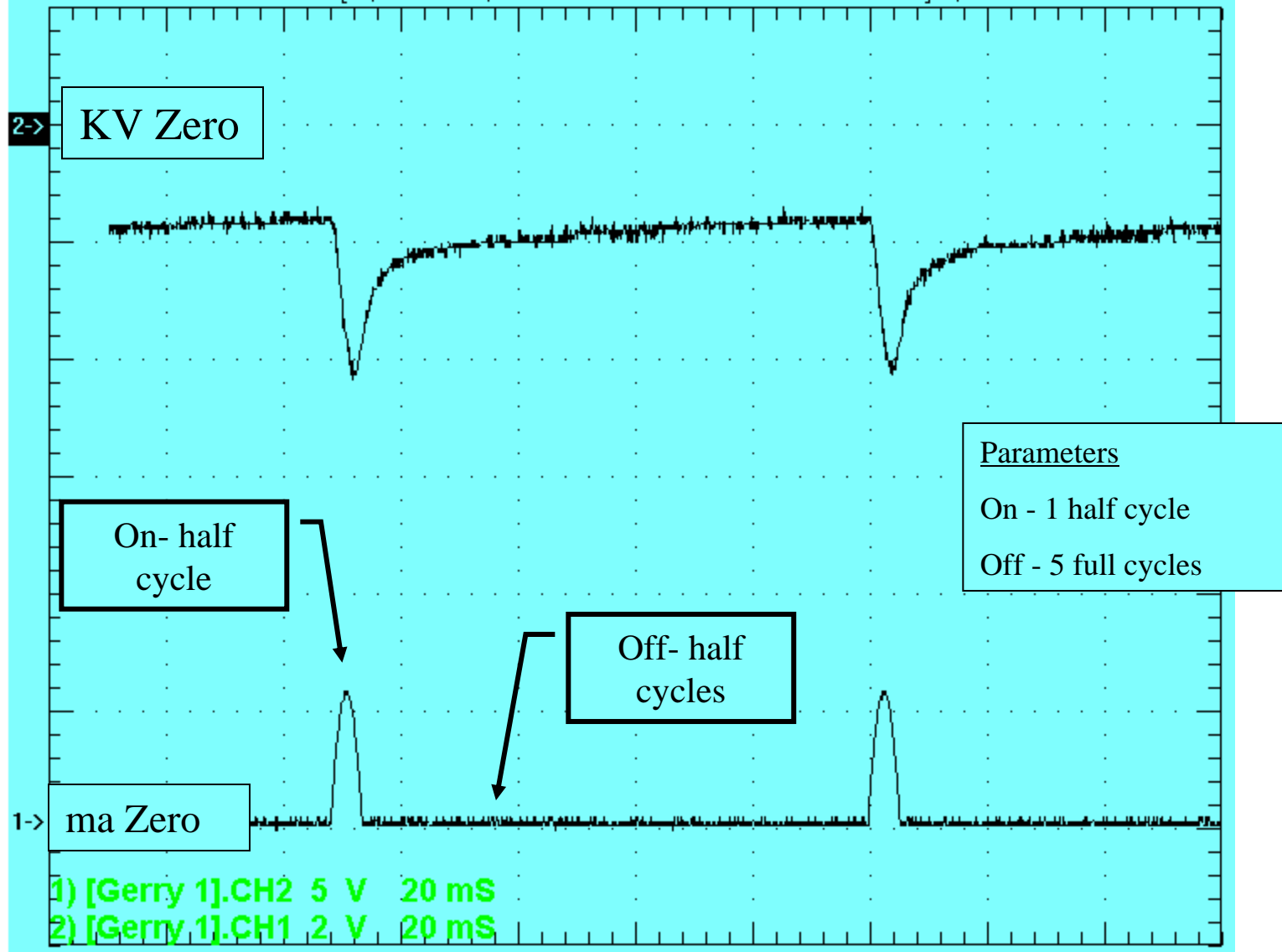




# What is the difference between Continuous Energization and IE (Intermittent Energization)

- **Continuous Energization:**
- The controls seek to maintain a high average voltage and hence power to the ESP by firing the SCRs every half cycle of supply unless a recognized event within the system determines otherwise.
  - The ESP is by all accounts continuously energized
- **I.E**
- Is achieved by alternately energizing the T/R set with a high firing angle for a specified number of half cycles and a low firing angle for a specified number of full cycles (unless a recognized event within the system determines otherwise)

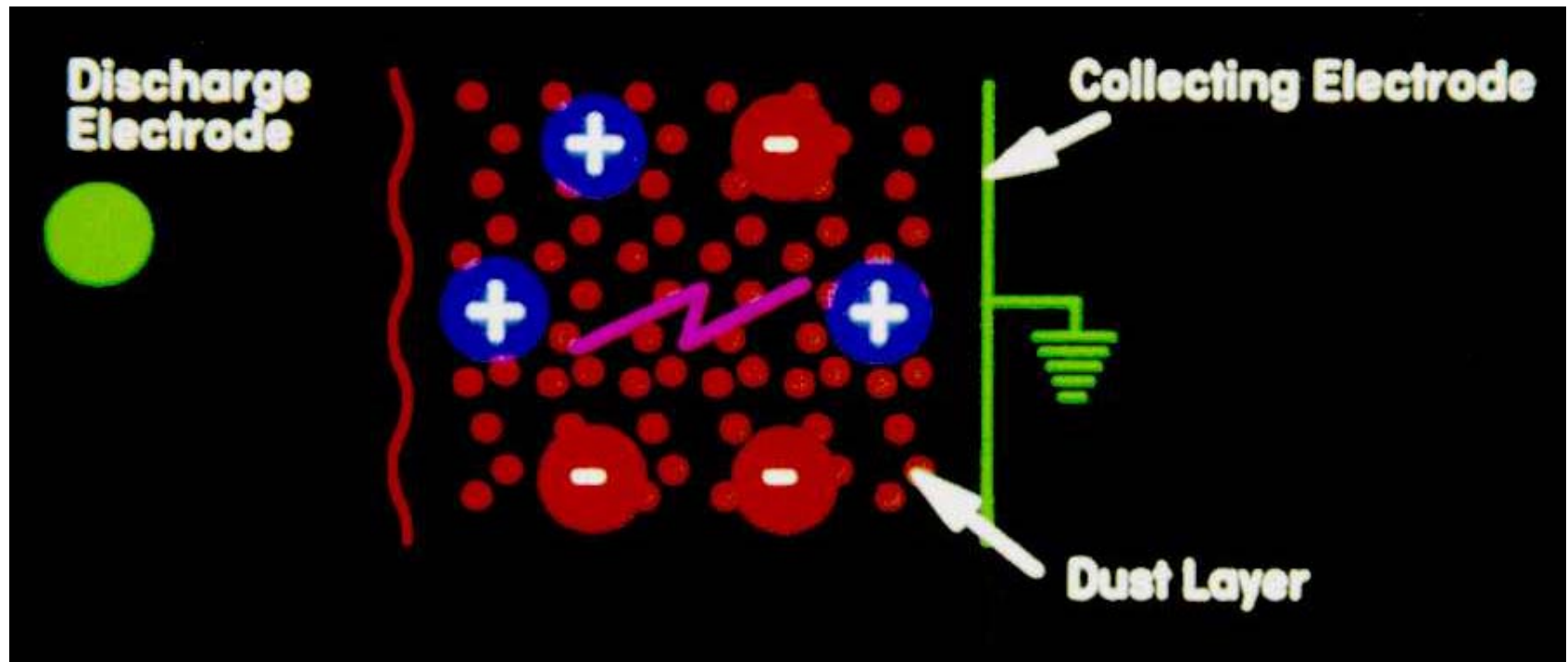
# Intermittent Energization





# When do we use I.E?..

When there's Back Corona!!



# Detrimental Effects of Back Corona

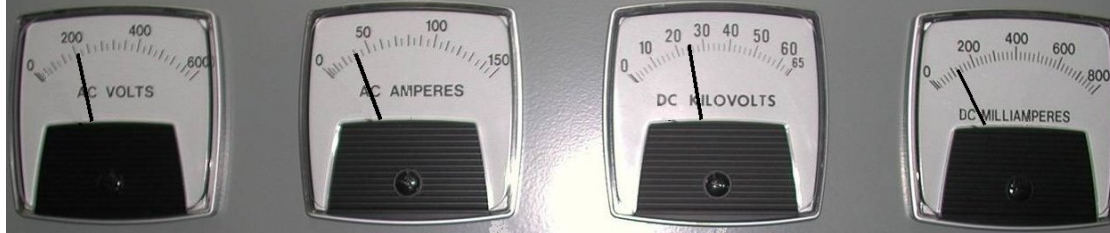


- Oppositely charged particles collide and cause charge neutralization
- The back corona may have with sufficient strength to cause the particles to collect on the discharge electrodes.
- Excessive dust to build up on the DEs causes poor current distribution which reduces ionic emissions.
- The DEs may now need more frequent rapping and so increased mechanical wear and process instability may result.
- The dust layer on the collector plates does not discharge completely by virtue of the retained potential so the rapping efficiency is reduced. Reduced power rapping may become required
- The current from the supply often increases and power consumption increases.

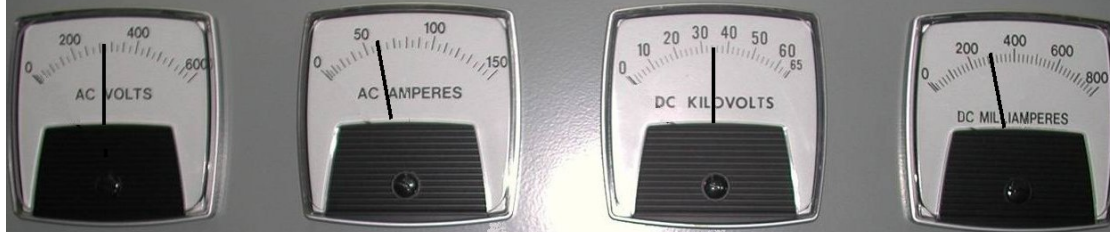


# The Meters

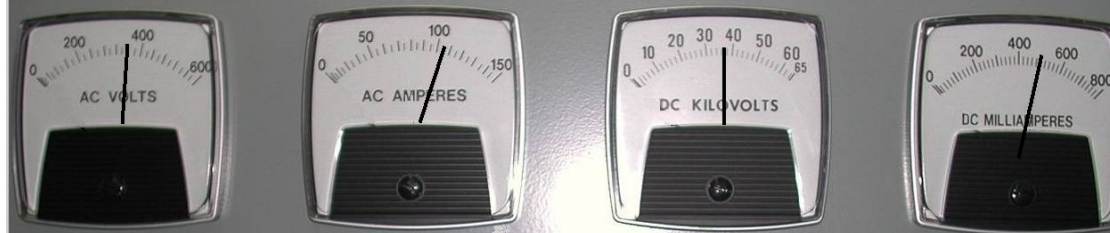
1st Field



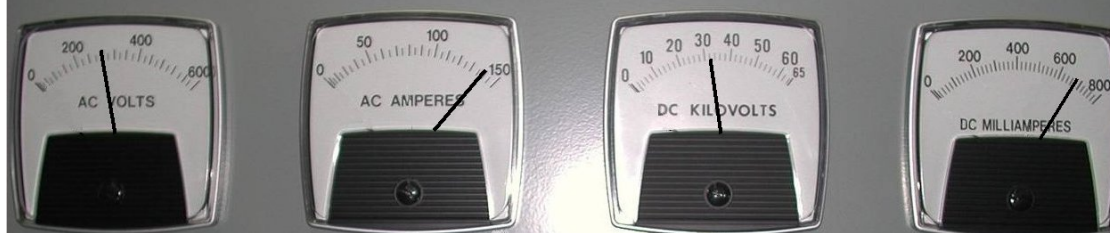
2nd Field



3rd Field



4th Field





## Is Training Important?

- The output of your operation depends on the cleanliness of your stack.
- The cleanliness of your stack depends on the ESP operating at optimum efficiency.
- Optimum efficiency will not occur unless the controls are optimized.

**YES it is important!**

