REINHOLD ENVIRONMENTAL Ltd.

2016 APC-Wastewater Round Table & Expo Presentation

July 18 & 19, 2016 in Dearborn, MI / Hosted by DTE Energy

$Fun_{always}Duh_{!}Mental_{us}$s to Load cycling

www.redkoh.com

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John Jannone

This is why we work on the Environment

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Redkoh Electrostatic Precipitator Controls Systems (ESP)

- ✓ **CREDENTIALS**
  - CORE BUSINESS ACTIVITY : ESP control and air pollution monitoring systems
  - HEADQUARTERED in Hillsborough, NJ, USA
  - EXPERIENCE : 34 Years of Electrical / Electronic Systems Design, Development, Manufacture and Installation.

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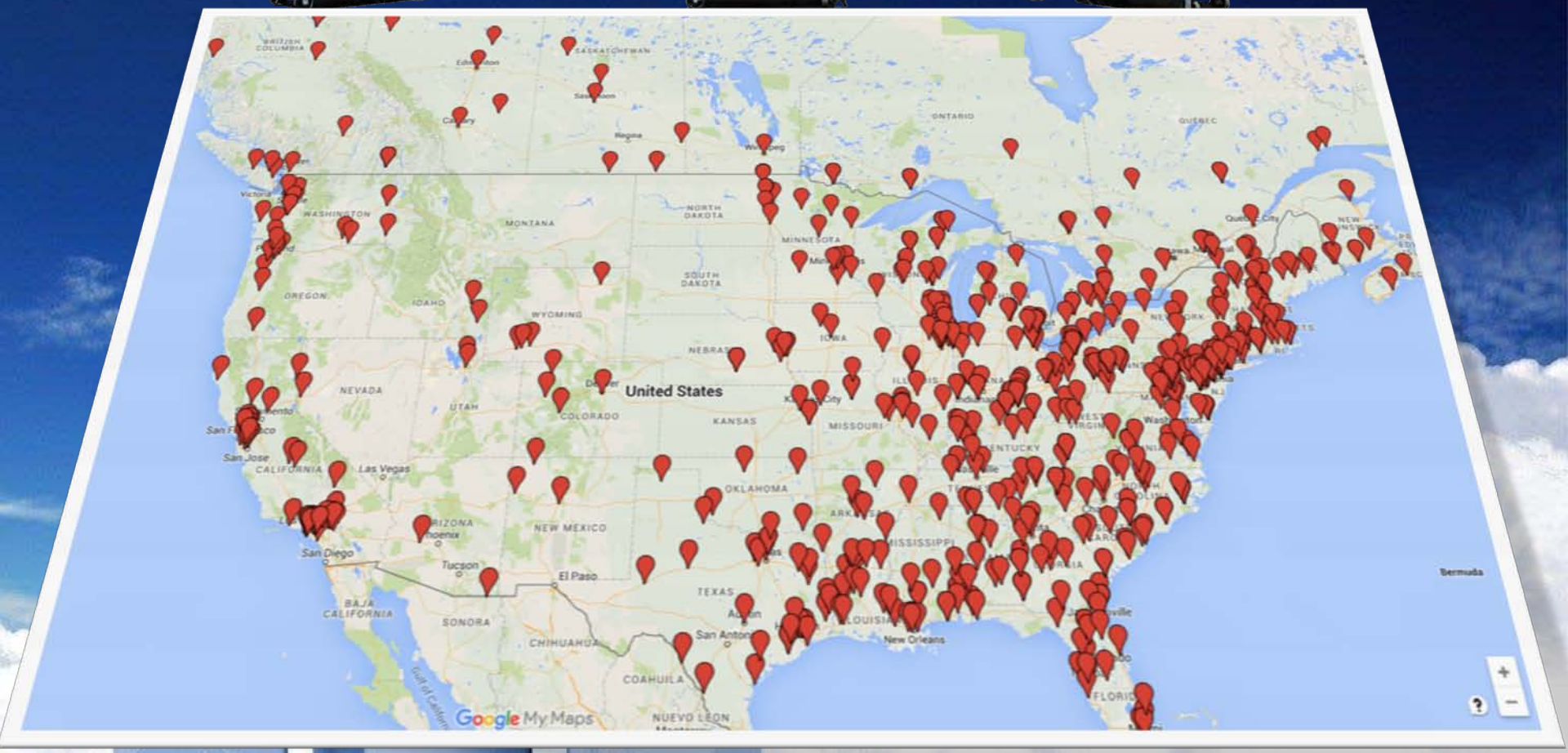
Some!!! of the Plant Locations that use Redkoh's Controls



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Some!!! of the Plant Locations that use Redkoh's Controls

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What is an ESP's Purpose?

To remove and collect suspended particulate from a gas stream by means of

ELECTROSTATIC FORCES

As compared to:

- *mechanical separators*
- *fabric filters*
- *wet scrubbing*

The tendency of any charged body or a particle to attract the oppositely charged body towards itself is called an Electrostatic force

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Electrostatic Precipitator (ESP)

- Electrical migration
- Electrical mobility
- Corona discharge
- ESP theory
- Charging mechanisms
- Ash resistivity
- Flue gas conditioning
- Power consumption

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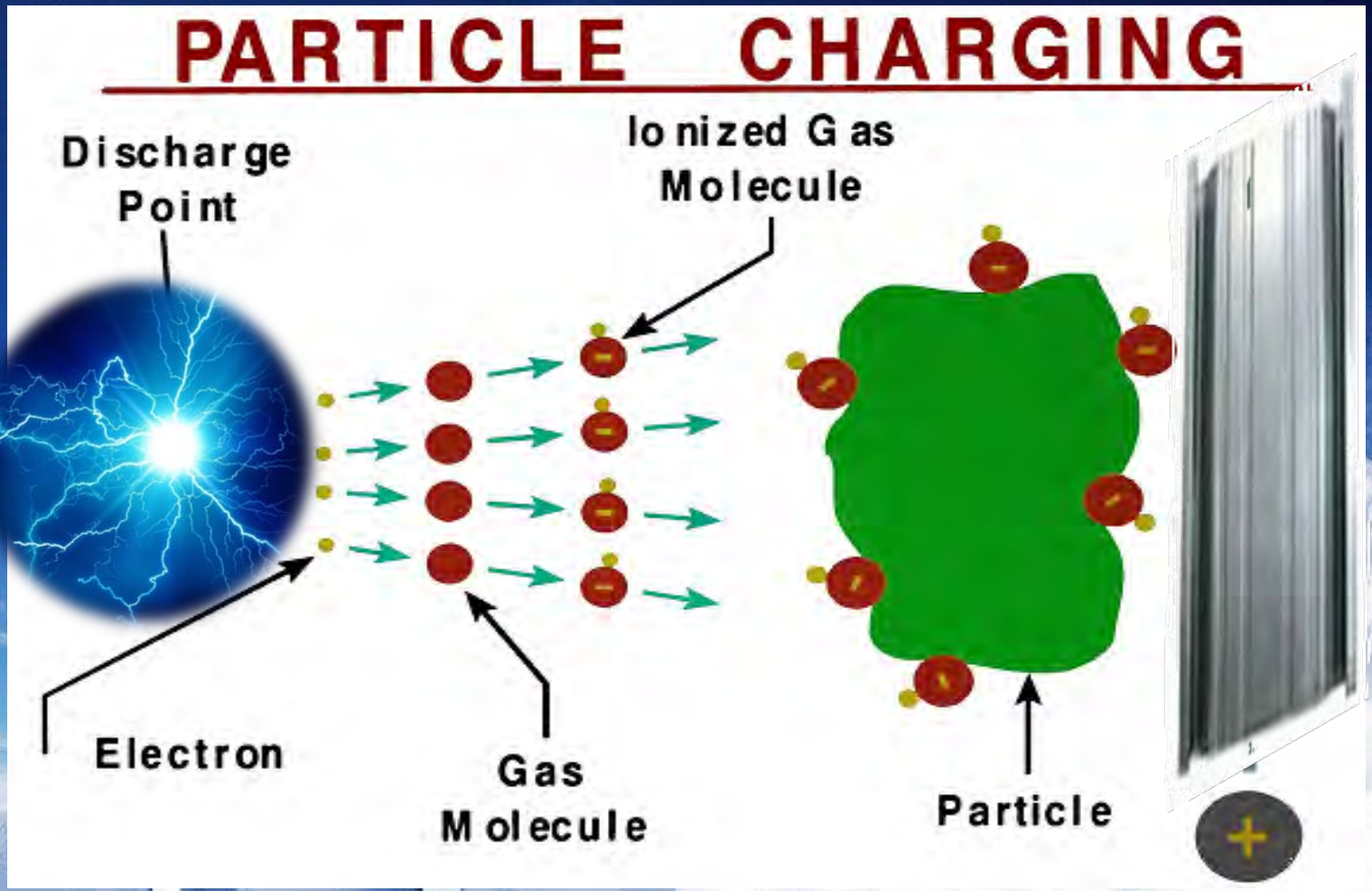
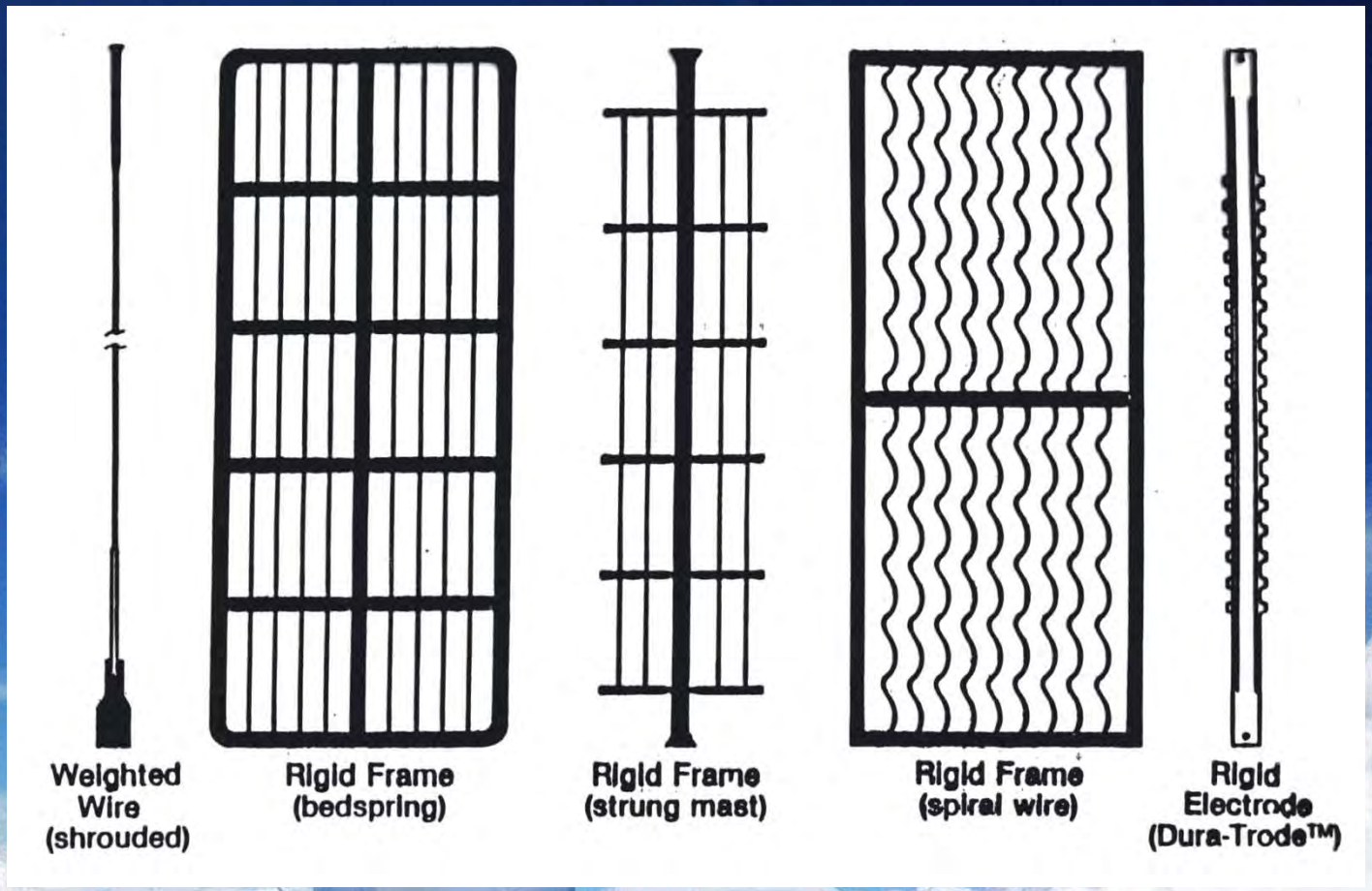
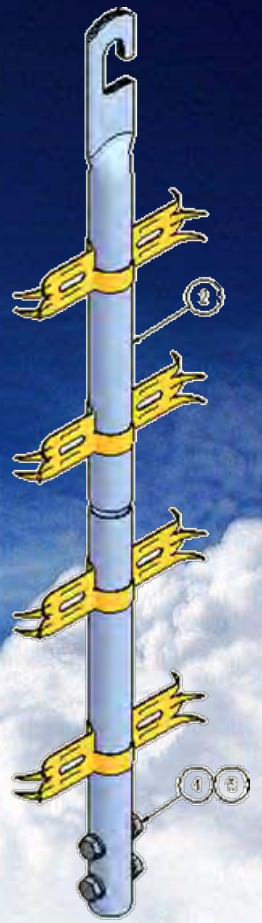
How an ESP Does its Magic



Discharge Electrode Types





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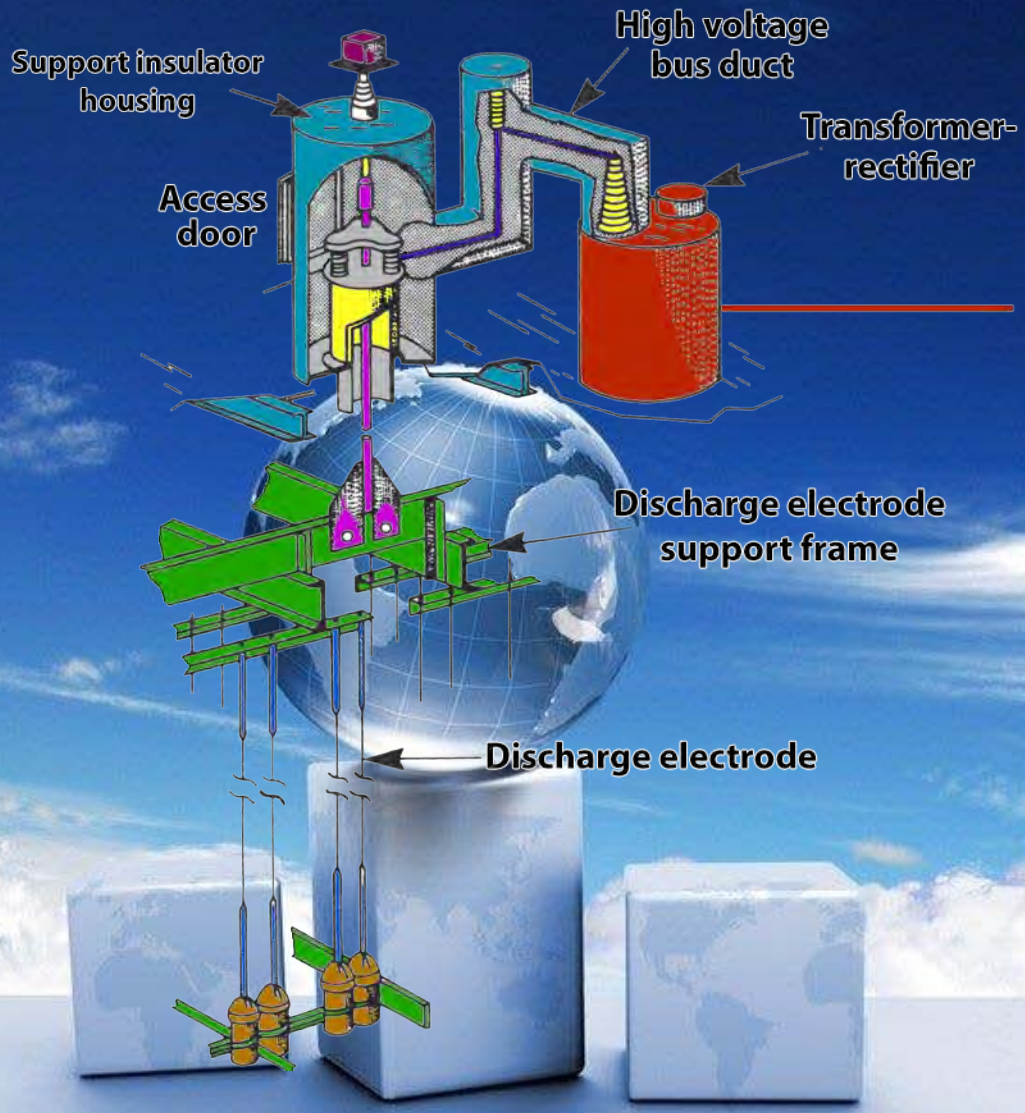
Where Does the High Voltage Come From?



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The Goals

- Maximize the average voltage to the ESP, while minimizing the peak voltage.
  - Reduce the peak to peak ripple of the secondary voltage supplied by the TR set to the ESP
- Precipitators spark most frequently at the peak of the applied KV.
  - Reducing the peak voltage while maintaining a high average voltage reduces the sparking within the ESP.
- Reducing the frequency of sparking reduces the voltage "downtime" on the ESP
  - Minimizing the downtime allows longer durations for the current in the ESP to build up.
- Higher average precipitator voltage allows more time for current to flow keeping the power levels to the maximum.
  - Higher power in the ESP promotes improved ESP collection efficiency.

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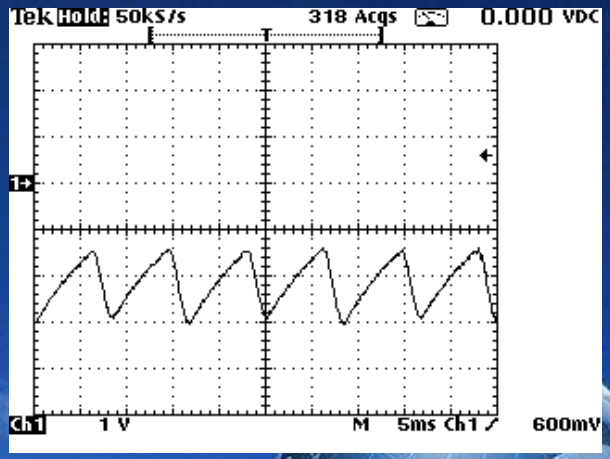
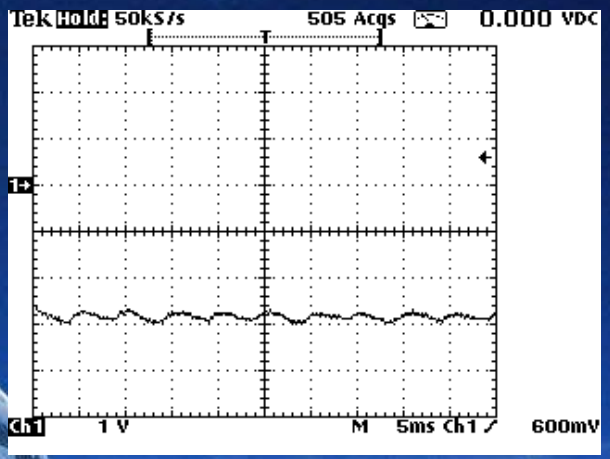
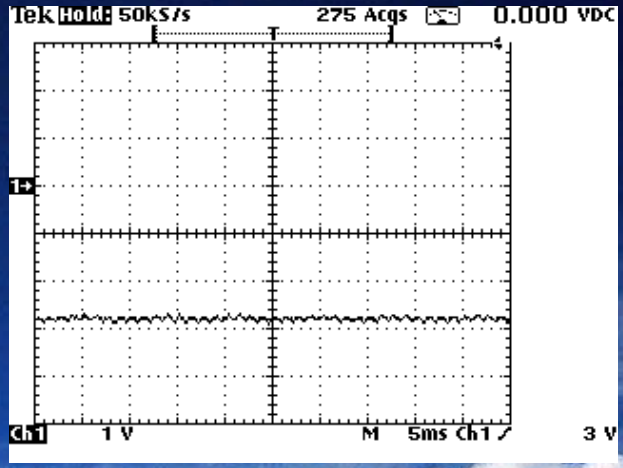
The Differing Techniques



60 Hertz – SCR
Energized



100 Hertz – IGBT
Energized



400 Hertz – IGBT
Energized

The ESP load for the above waveforms is identical. Only the method of energization differs

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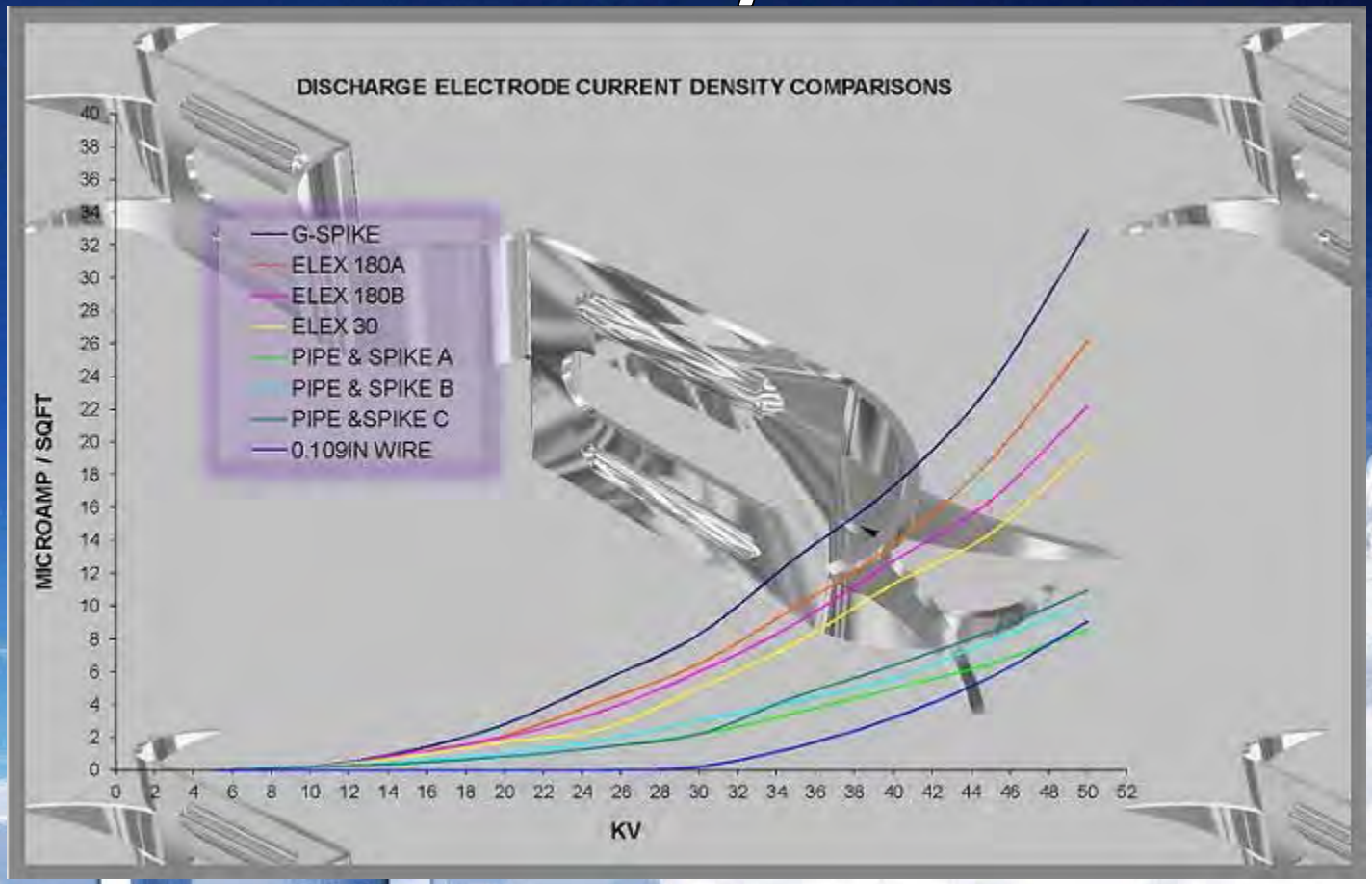
The Relationship between Volts and Amps



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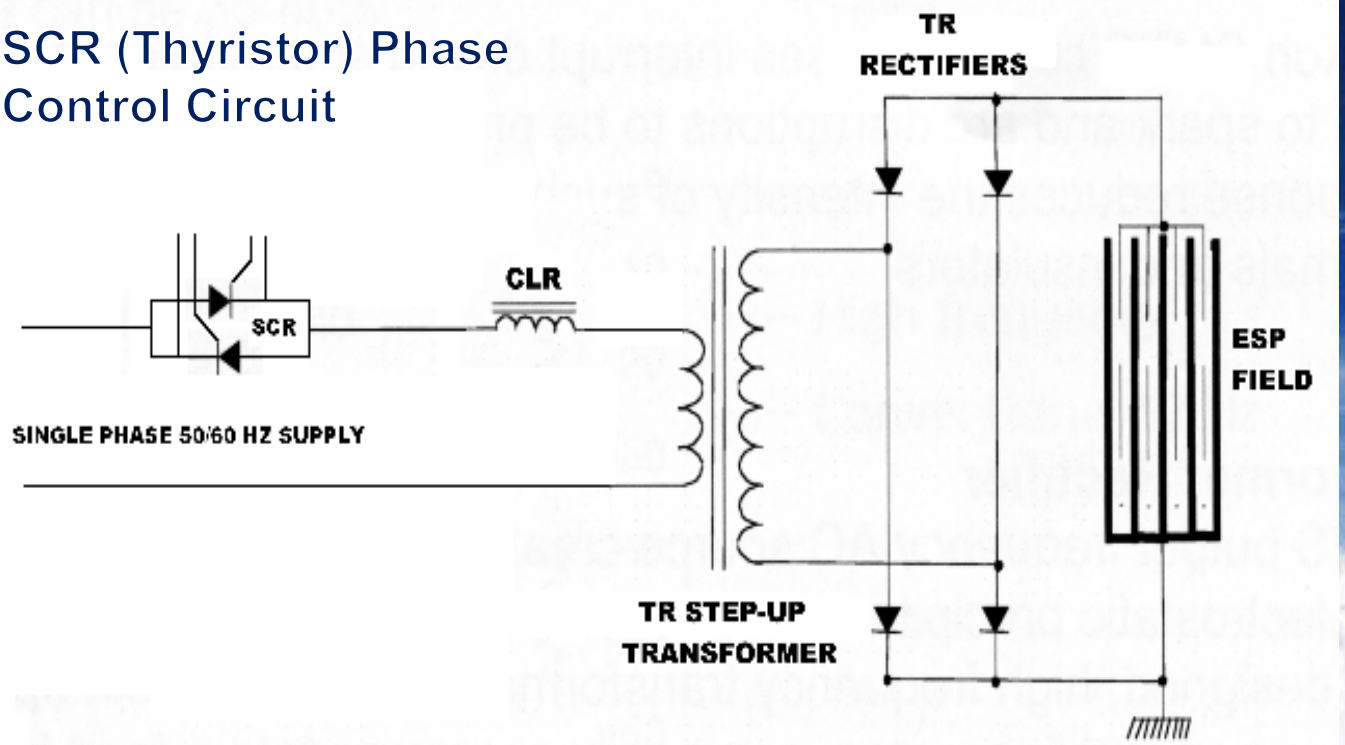
How does a single phase (60Hz)Transformer-Rectifier (TR) get its power?

SCR (Thyristor) Phase Control Circuit



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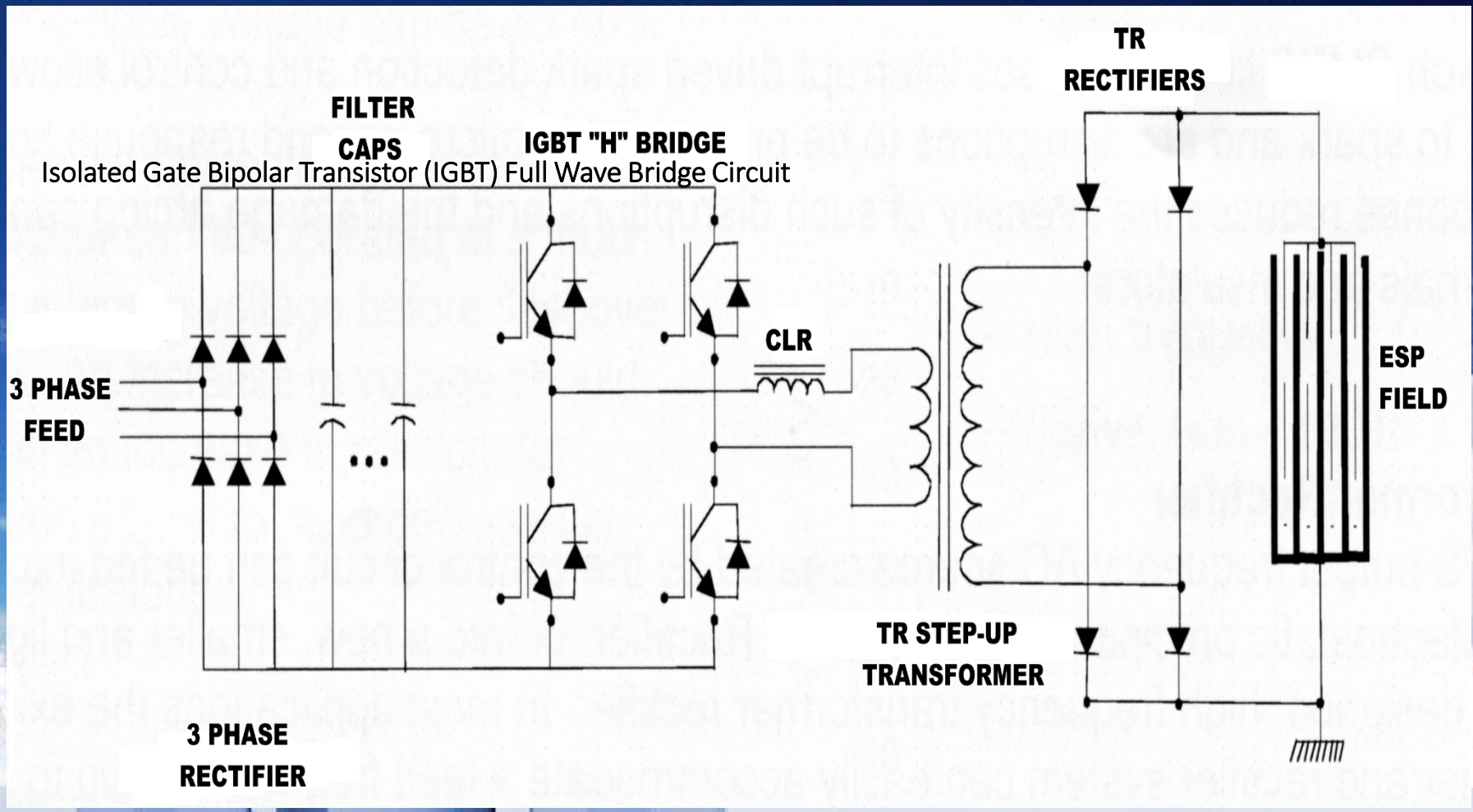
How does a Switched Frequency Transformer-Rectifier (TR) get its power?



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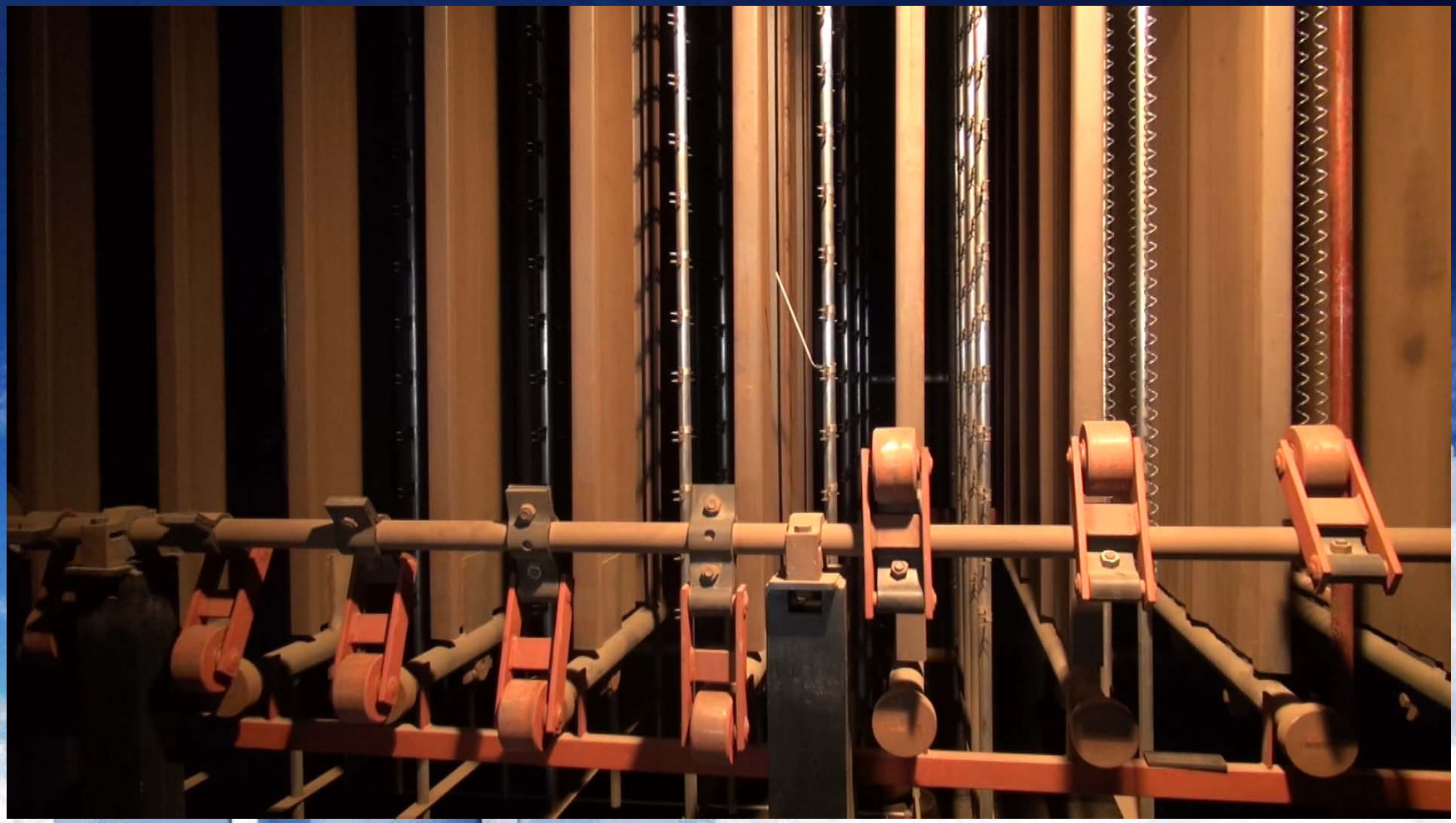

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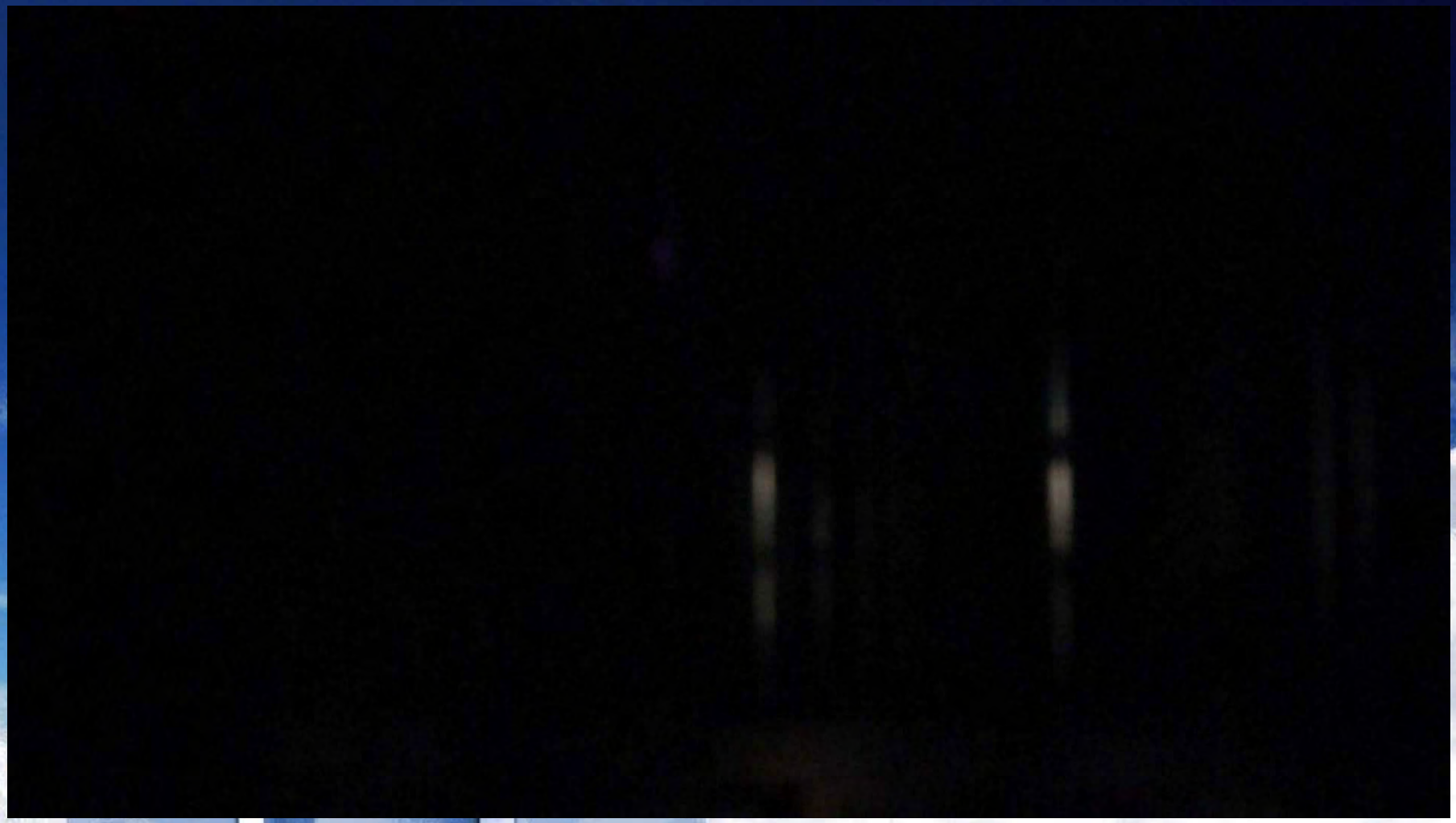

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What Electrical Readings Can Tell Us

- **When Discharge Electrodes are Built-up**
  - **Secondary current will be suppressed while secondary voltage is relatively normal**
- **When Plates are Built-up**
  - **Secondary voltage and current will be suppressed on a cyclic basis**
- **When ESP is overloaded with Particulate**
  - **Both voltage and current are low, usually due to sparking at lower than normal KV levels**
- **When a TR is Grounded**
  - **Primary voltage will be very low while secondary and primary currents are at or near maximum**

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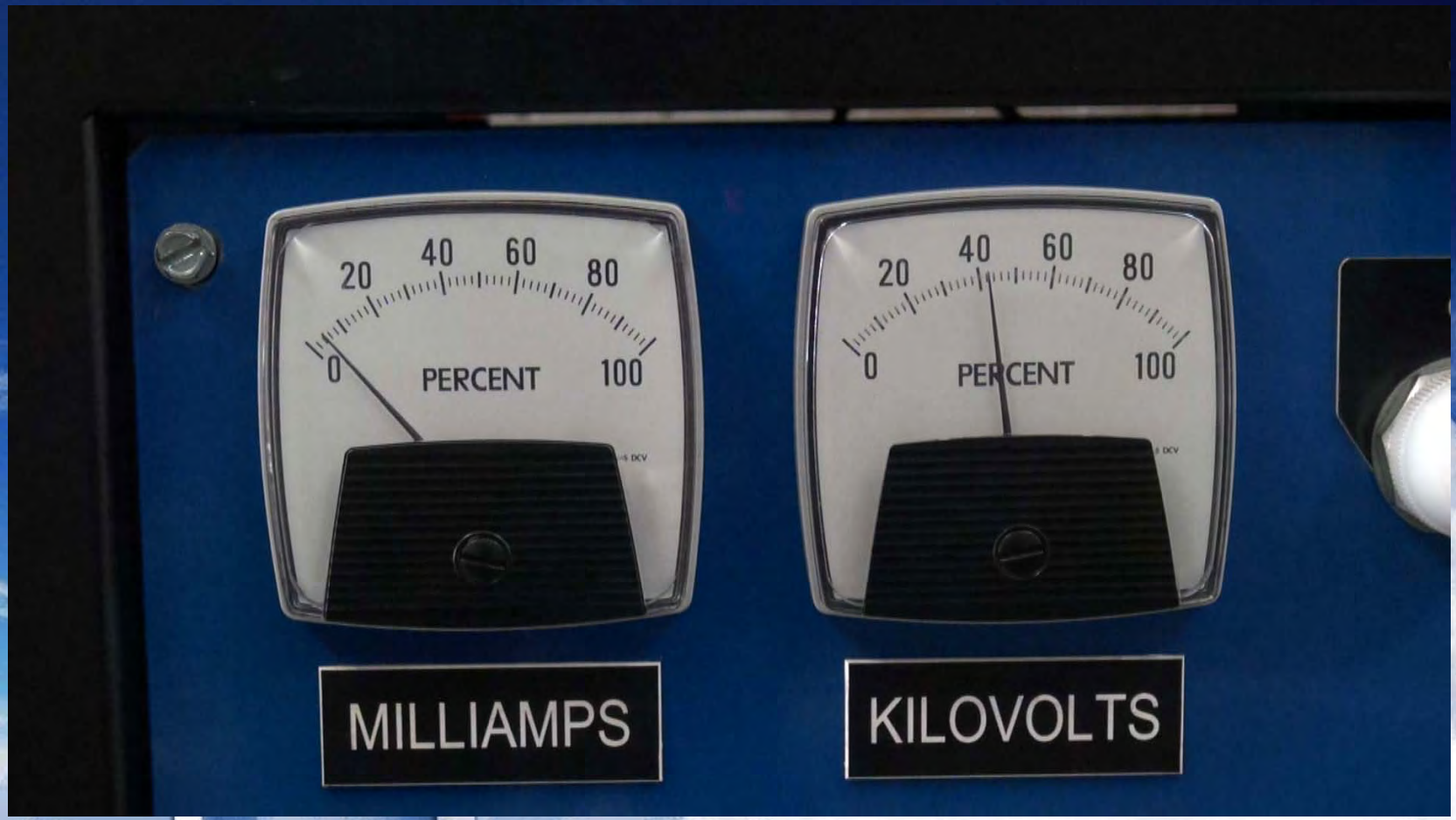
KV and MA from the meters



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KV and MA from a scope

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FLUKE 199C SCOPEMETER COLOR
BWL 10kHz
MANUAL
A= 2 V
500ms Trig: Al
B= 1 V
SCOPE
METER
RECORDER
CURSOR
ZOOM
REPLAY
TRIGGER

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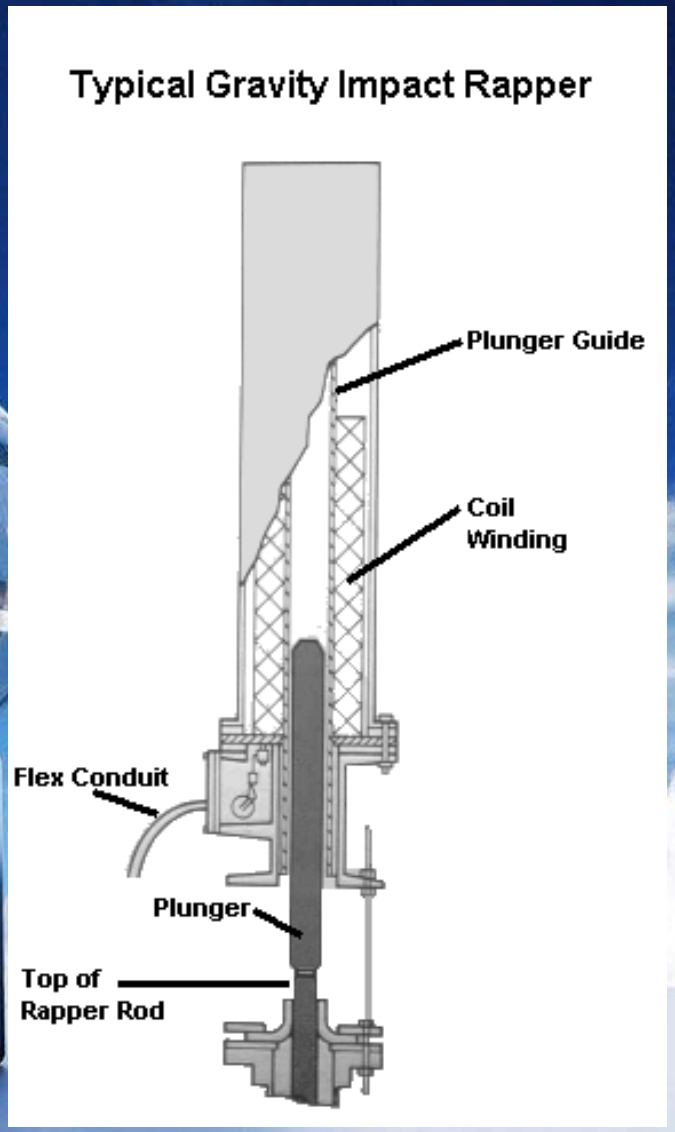
Impact Rapper Assembly



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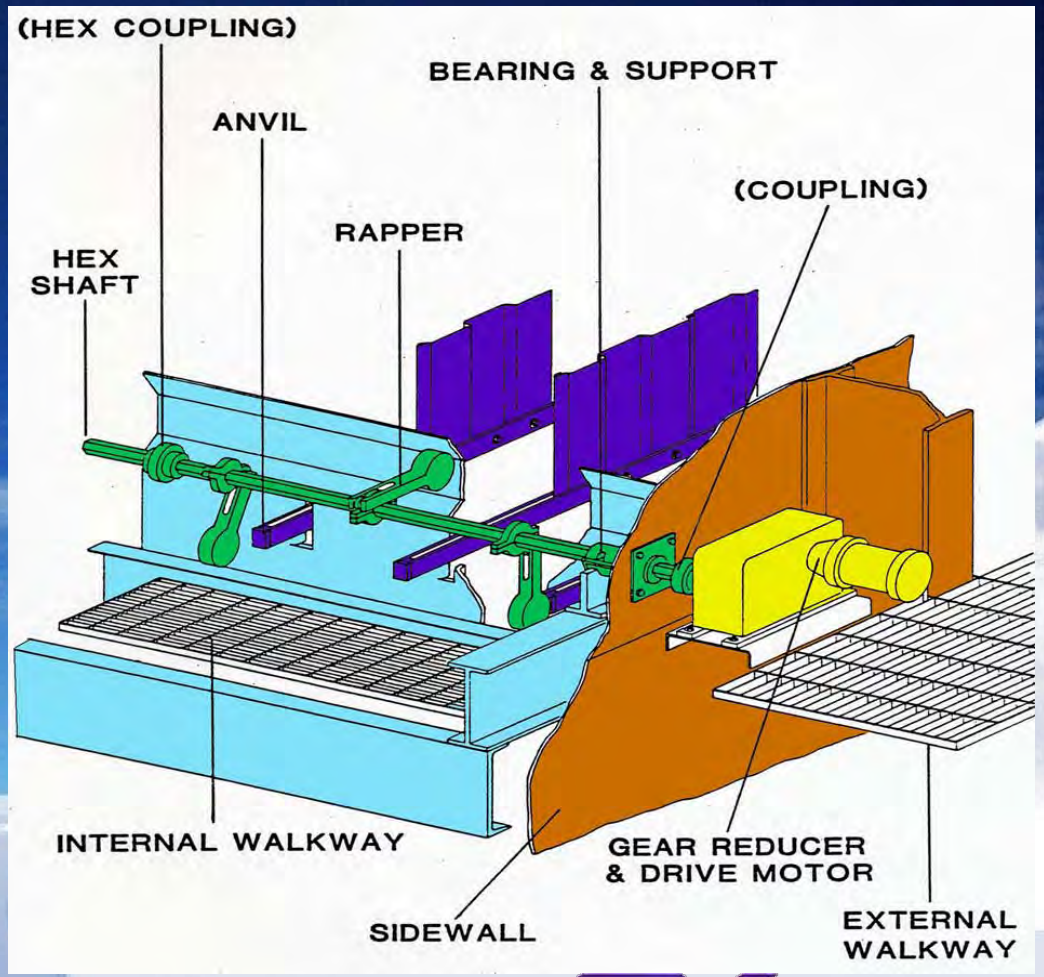
Impact Rapper

Tumble Hammer Rappers



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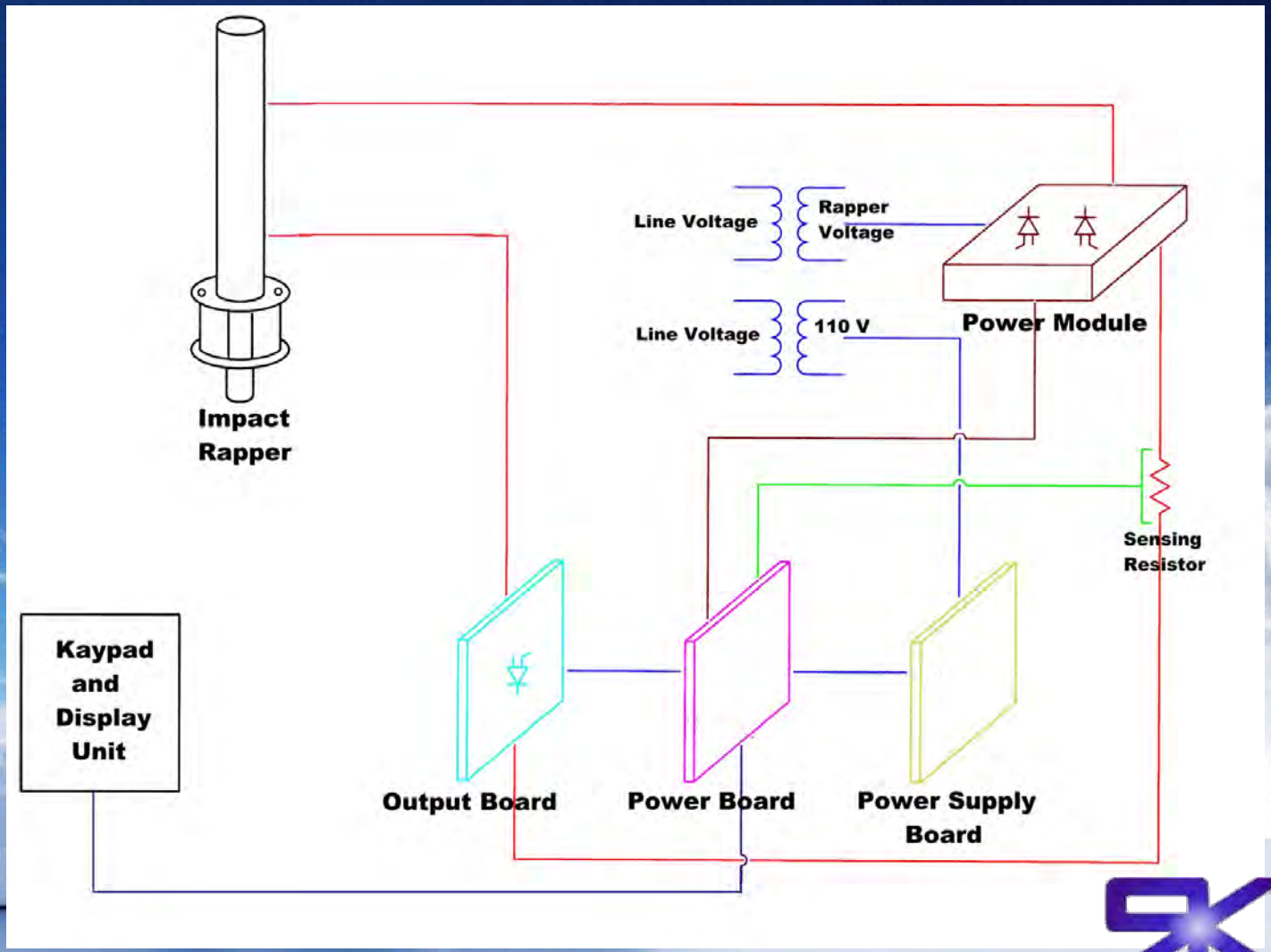
Rapper Power System



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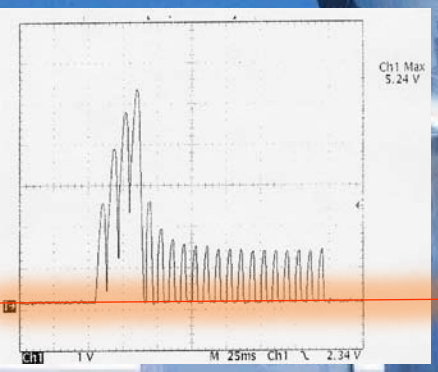
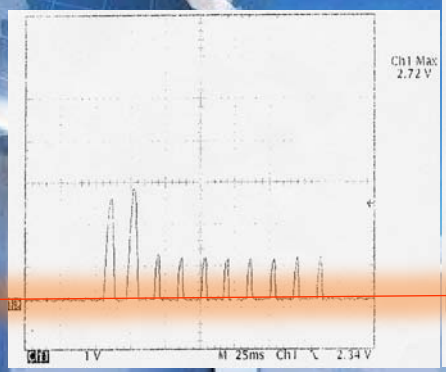
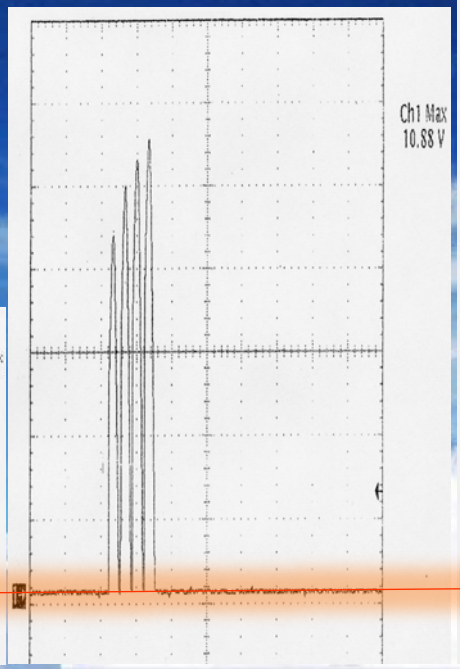
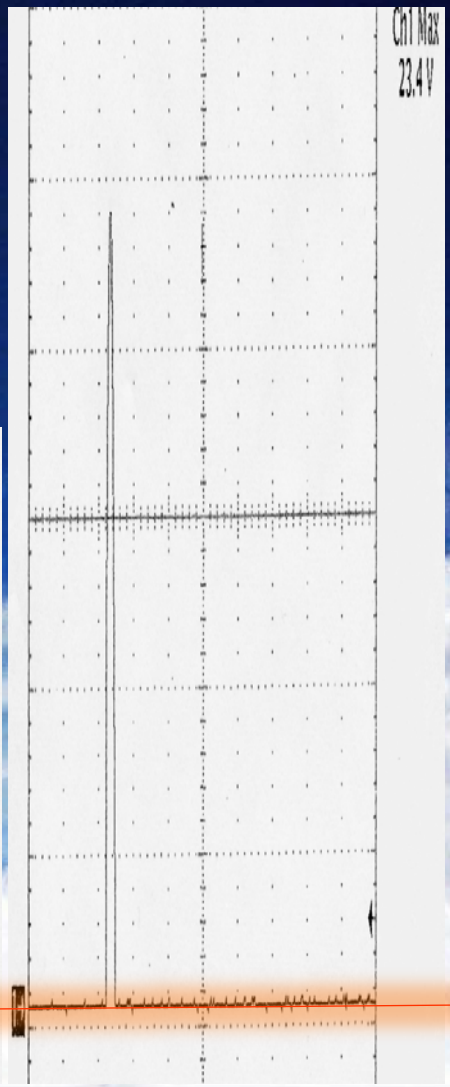
Current Draw in an impact Rapper









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Cycling and the Performance Impacts on ESPs

Unfortunately, nothing happens in isolation. Change is rife!

- Gas velocity and volume
- Rapping Strategies
- Temperature
- Particulate size
- Unburned carbon

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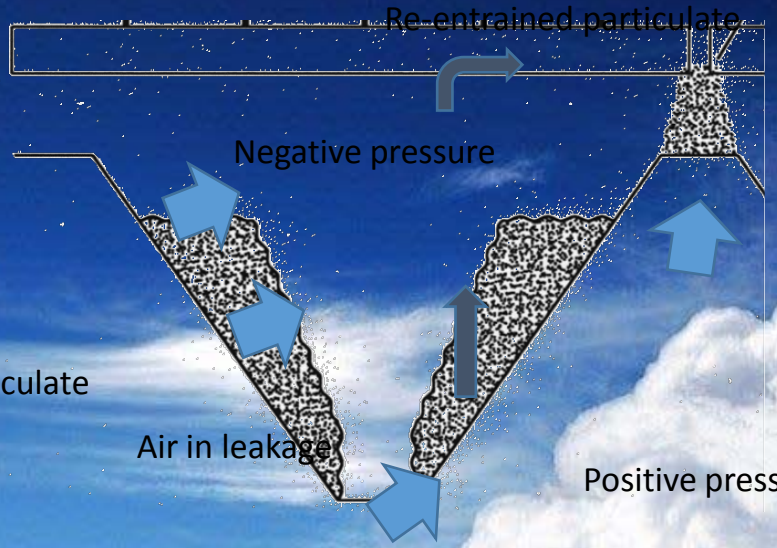
Re-entrainment



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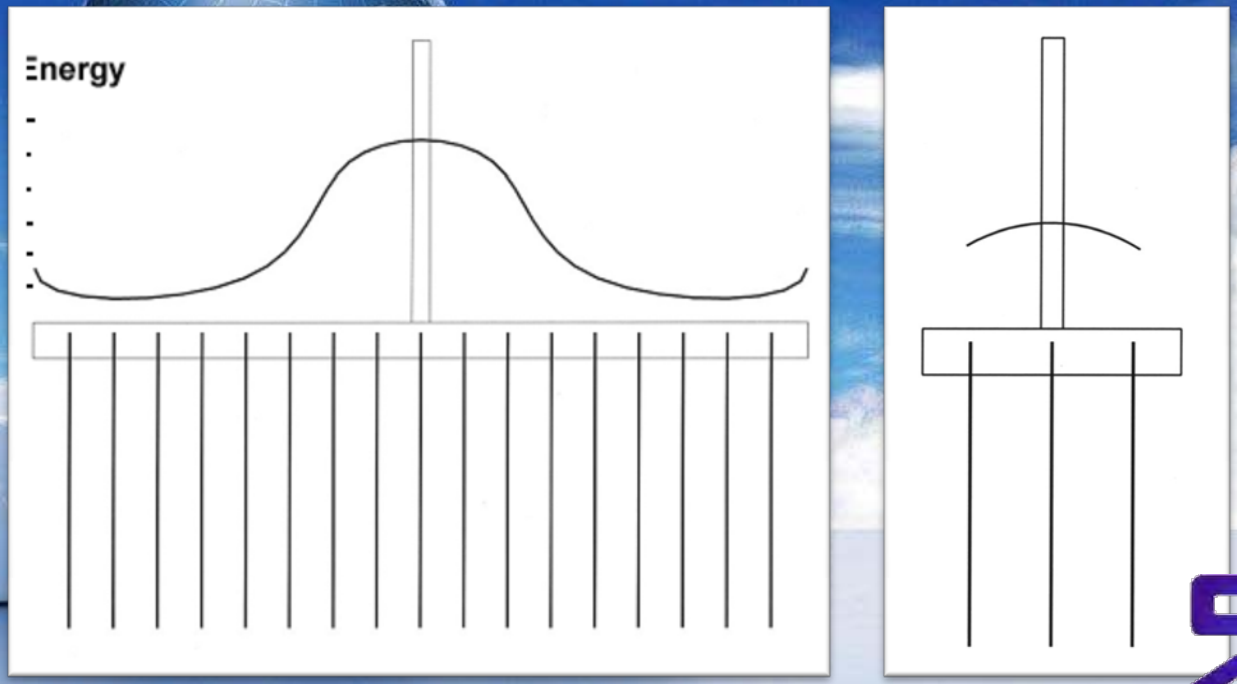
- Rapping Too Frequently Prevents Agglomeration
  - Results in continuous re-entrainment and elevated opacity/emissions
- Rapping Too Hard Causes Lateral Release
  - Results in spiking/puffing, especially towards the outlet where there is no backup field
- Too High a CE Rapping Density Results in:
  - Clean plates below the point of impact
  - Dirtier plates at the outboard areas
  - Re-entrainment of particulate when rapping energy is increased to keep outboard plates clean

Optimization - Trial and Error – Experience



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Temperature

Power Source – SCR's or contactors
Temperature Controllers – discrete or PLC
Coordination – PLC or DCS

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Hopper Cleaning Devices

Power source / control
AC vibrators – Contact and non-contact
Pneumatic Vibrators
Impact Rappers
A BIG Hammer

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Steel surfaces

Corrosion free
Hole free
Scale free

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- Although the precipitator is a rather simple device in terms of the basis of operation, there are numerous factors that can both positively and negatively effect the day to day efficiency.
- Stay aware of what these factors are, understand their effect, and optimize them for best performance.
- There are consultants who have spent their lifetime solving precipitator problems on a daily basis. Don't be shy about asking for help. In the long run it will save you time and money.

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