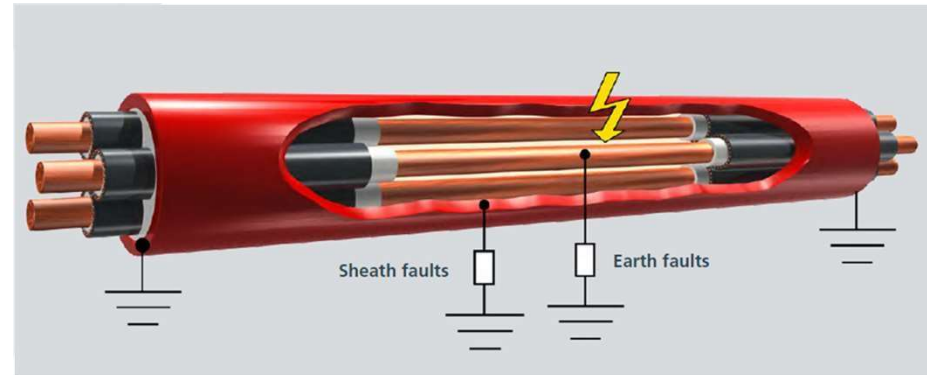


# PPA Virtual 2021:

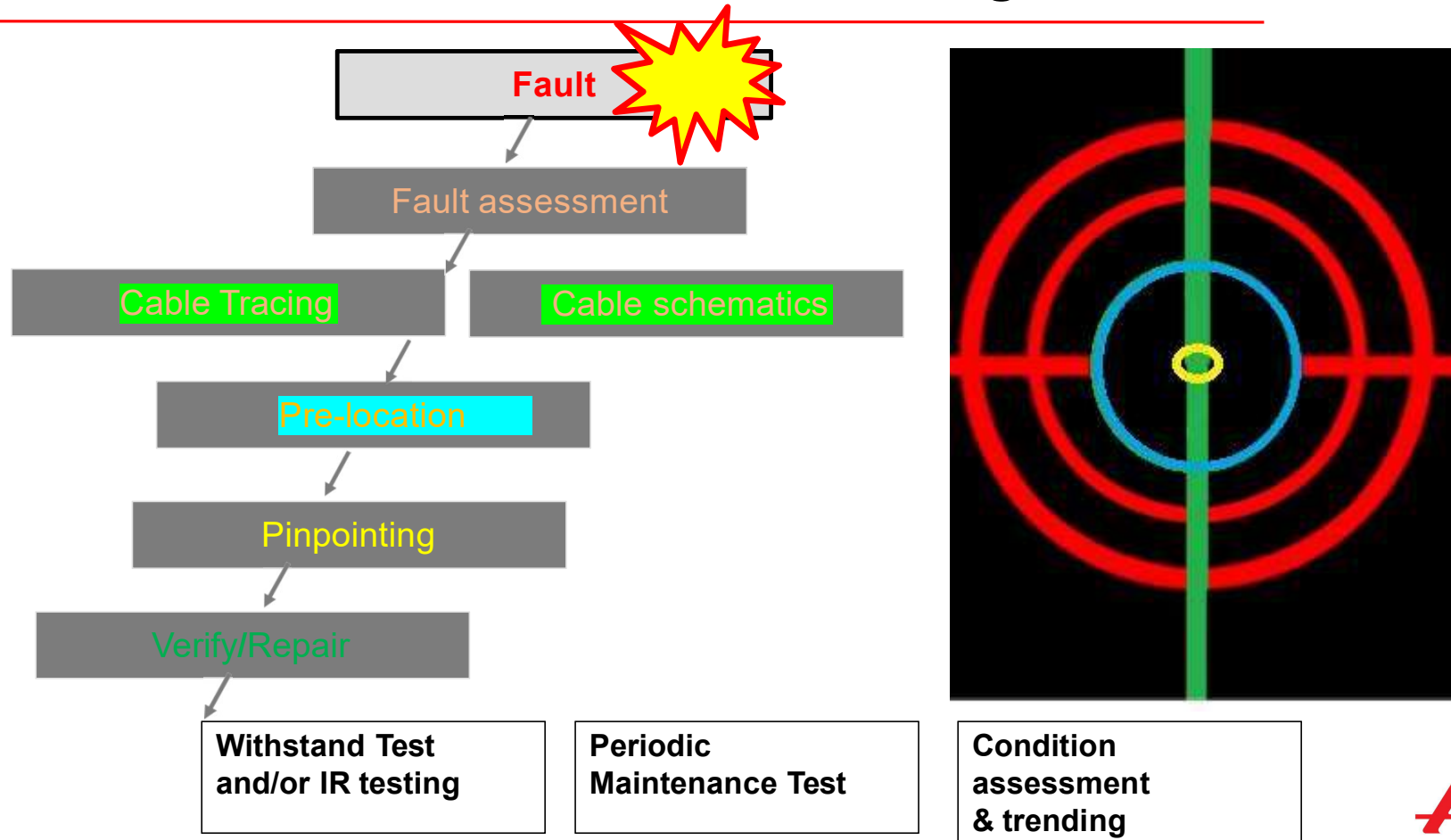
## Part 1: Essential developments in cable fault finding



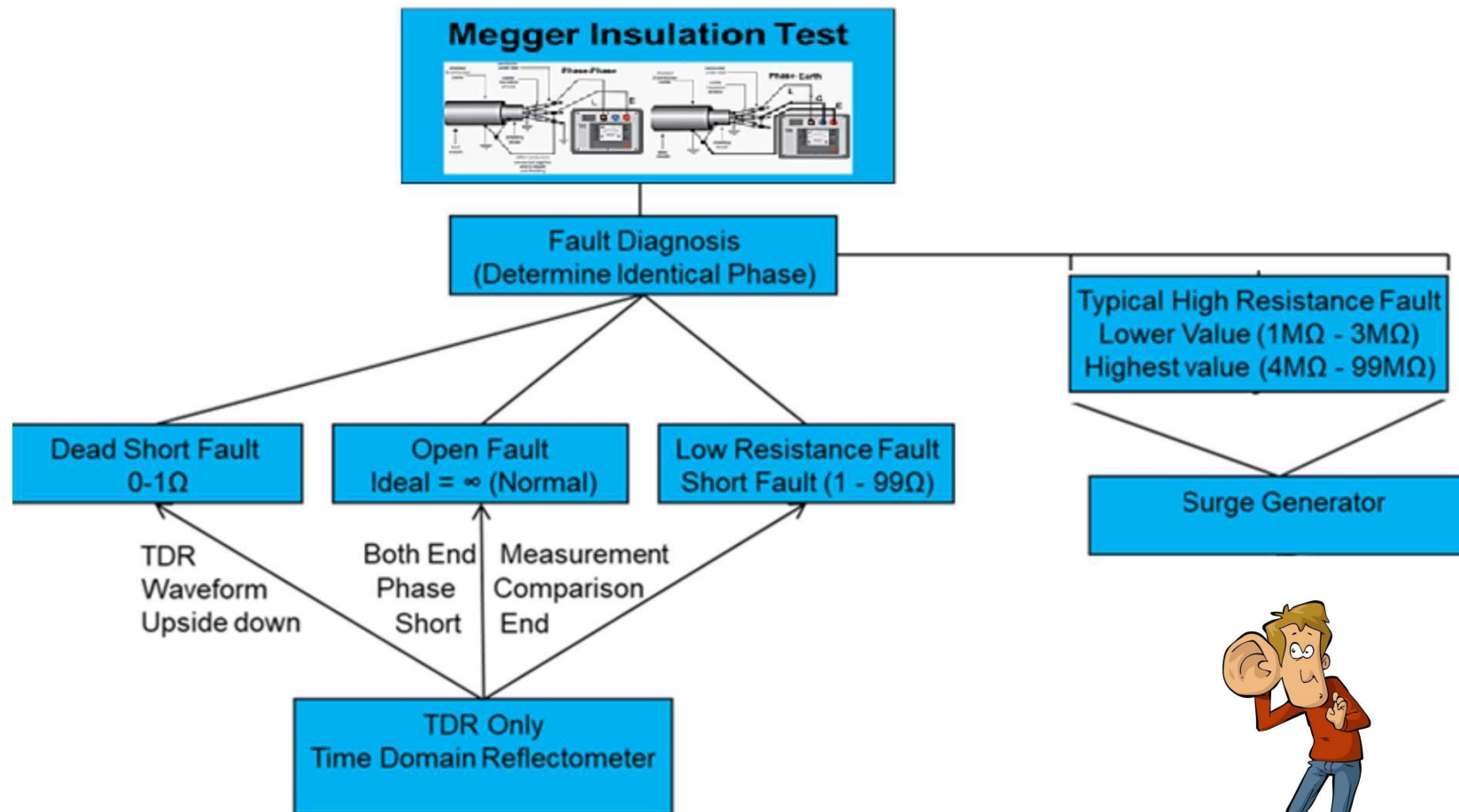
Louwrens O'Connell  
Business Development Manager - Power

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# Fault Finding Process



## Type of faults and historic approach



## TDR only summary:

- Fast,
- Safe and non-destructive (LV DC pulse)
- Portable
- Good for open circuit faults and short-circuited faults.  
(Especially in multi-core cables)
- Economic option

Pre-location only. (No pinpointing)

No high resistance and/or wet faults.



## Surging/Thumping only summary:

### ■ Finding the fault with surging/thumping?

- Breaking down high resistance of the fault making it possible to,
- Listening for the fault (pinpointing the fault)
- By using emf acoustic equipment to enhance hearing.
- Major disadvantage: No Pre-location

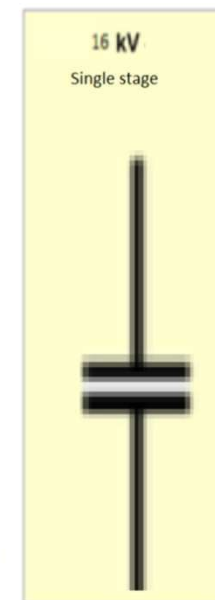
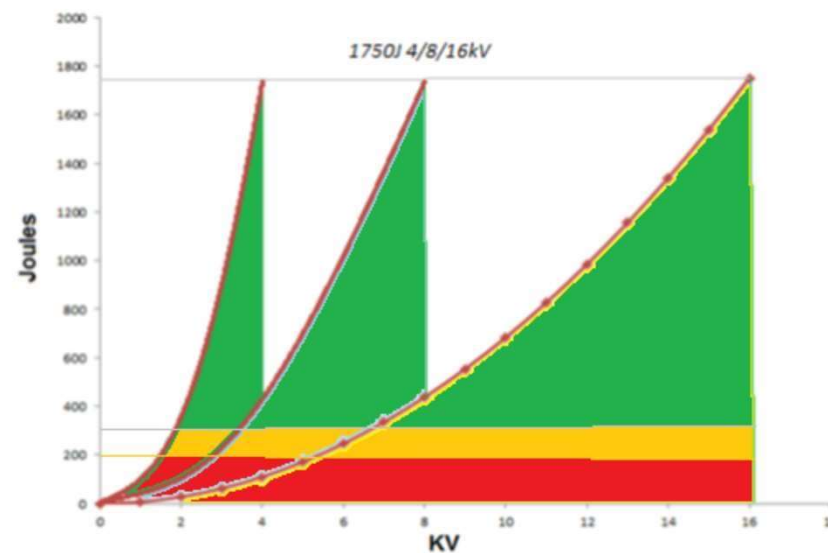
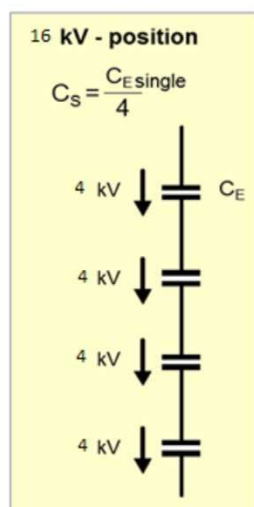
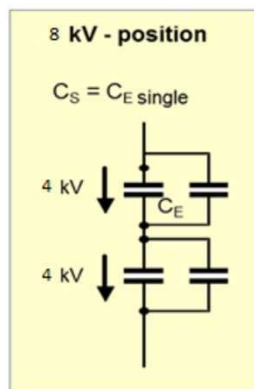
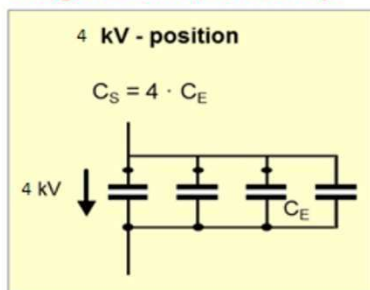
### Challenges and warning:

- Longer cables without pre-location leads to long thumping episodes
- Single stage thumpers require higher voltages to enable higher joules (*next slide*)
- Over-thumping can change the condition of the fault and possibly damage the global insulation condition of the cable.



## Important for surging units: Multi stage SWG

### Surge Generator Set-Up

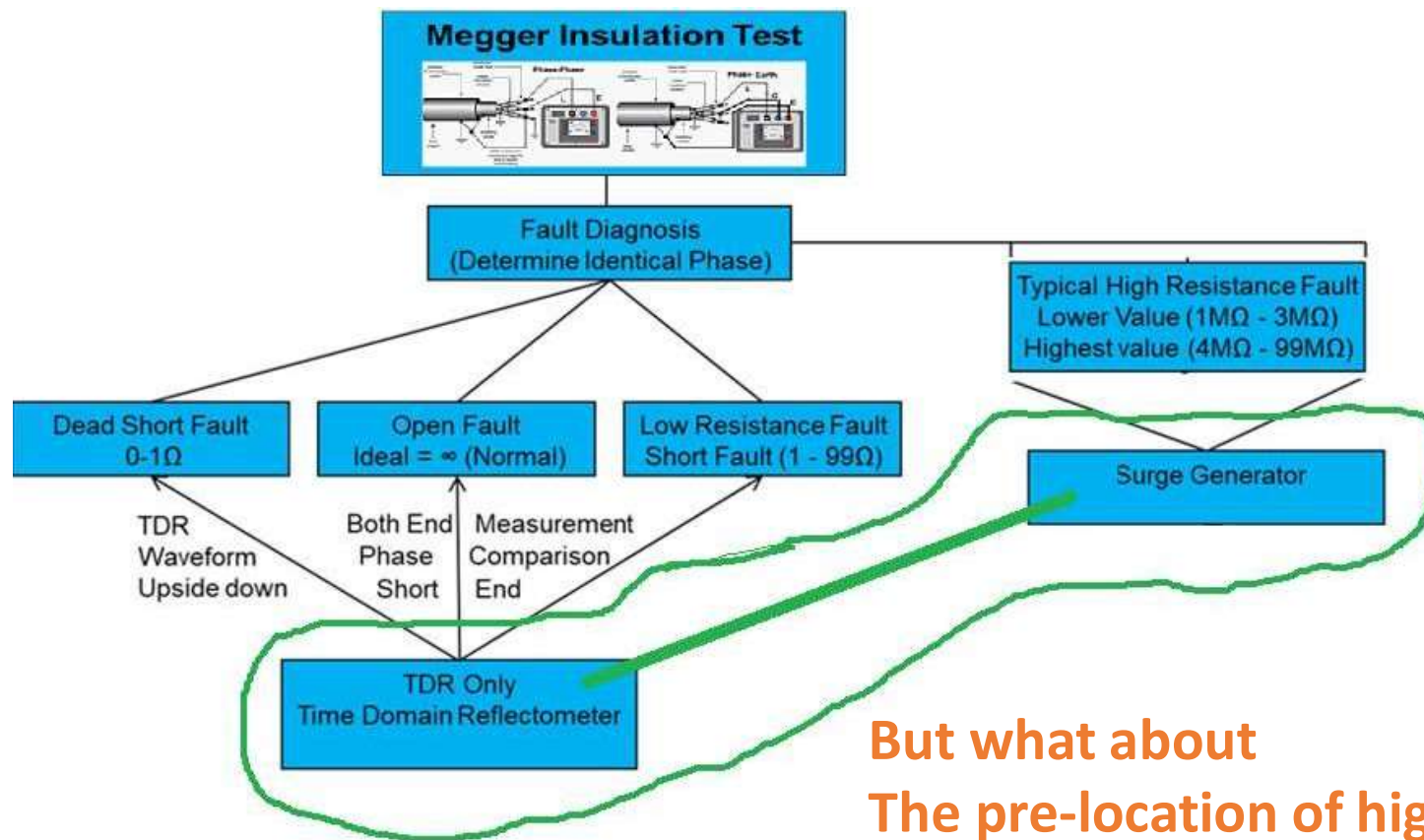


Surge energy

$$W = \frac{1}{2} C \cdot U^2$$

Note: Audible threshold for faults typically  
**250Joules**

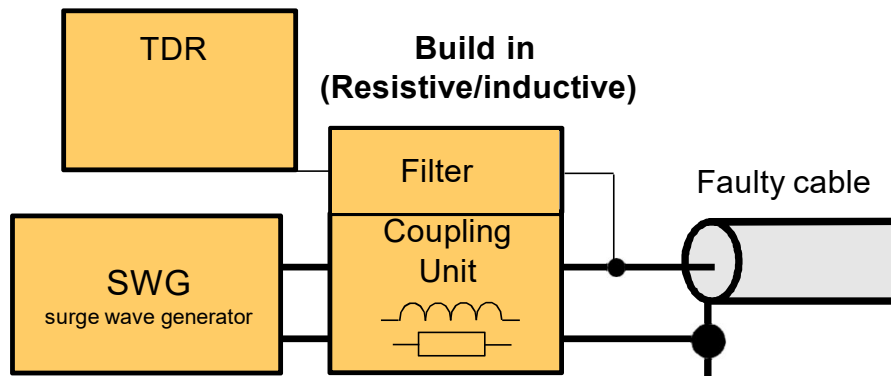
Both units:



But what about  
The pre-location of high  
resistance faults  
(Majority of MV/HV faults)

## The Solution for HR pre-location:

- Arc Reflection Measurement (ARM)
- TDR of high resistance faults
- First Generation (resistive coupler)

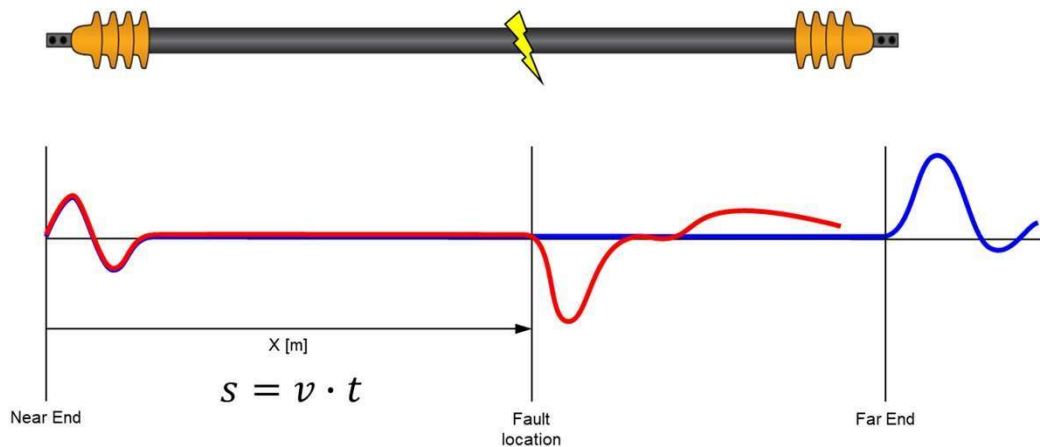




## Pre location: ARC Reflection

### ■ ARM is a two-step-process:

- Overlay of 2 traces
- LV Reference measurement + HV Fault measurement
- Radar + Surge Wave Generator (thumper)
- Surge capacitor single discharge



## Aadvancements in portability and software:



- Latest CFL technologies:
  - Small, portable, robust units perfect for LV to 11kV networks.
  - Gone are the days of 100kg+ cable locators
    - Battery powered units weigh approx. 30kg
  - Fit in the boot of a car or back of ute.
  - Substantially cheaper
  - Simple intuitive software aiding with fault finding

## Part one Summary:

### Cable fault finding pre-location: Summary

---

- With TDR and ARM combination units, both high and low resistance faults can be pre located and pinpointed. This will minimize surging and avoid over-thumping of cables.
- With the combination of proper **staging** the already minimized surging can further reduce surging to **safe surging voltages**
- If we then add **intuitive software** and the ability of **acoustic emf pinpointing** equipment, the combined benefits result in,



Smarter, faster, lighter and safer cable fault finding, while avoiding damage to the cable life.

No more unnecessary overtime.



## **Part 2: Importance/Reminder of testing transformer oil**



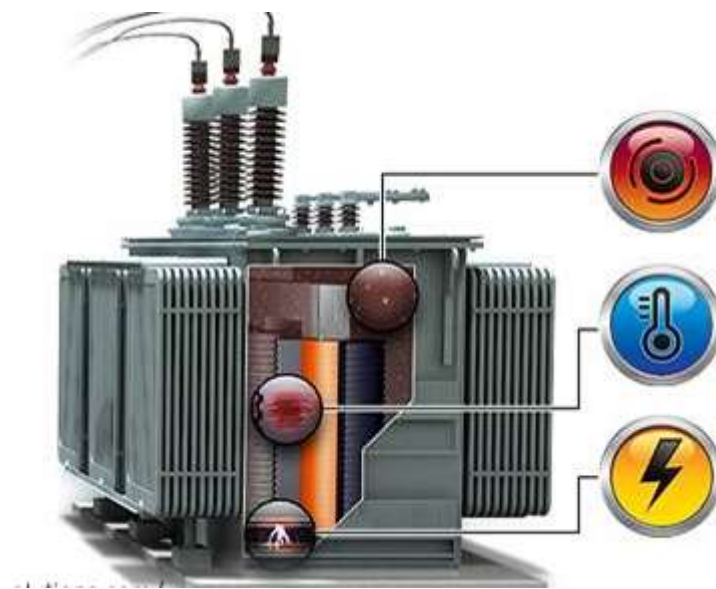
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- Mineral Oil is an efficient **coolant** with a high flash point and high dielectric strength when used as an **insulator** in transformers
- The insulation properties can (will) **change** due to oxidation, acids, sludge, gas and water absorption.
- These changes will eventually lead to unexpected, catastrophic transformer **failure**.

#### How to prevent:

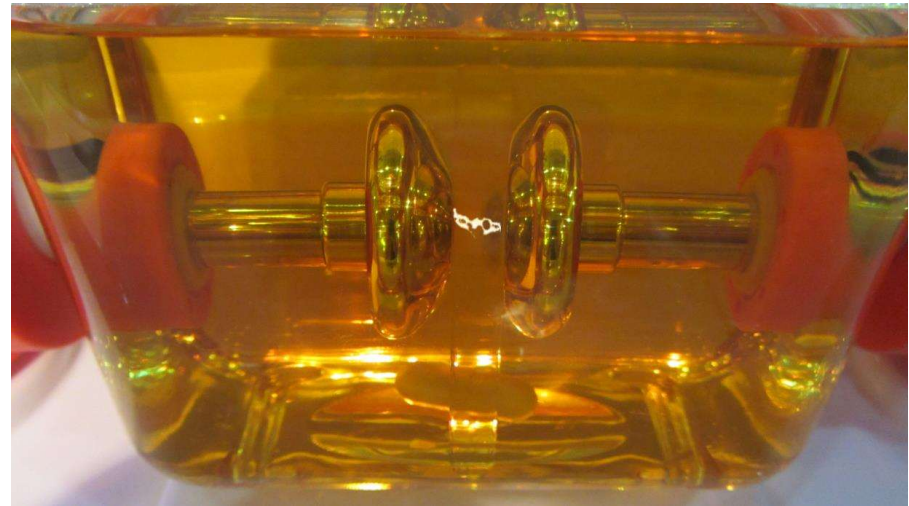
- **DGA** analysis and oil **dielectric strength**  
**Dielectric strength focus.**
- This is arguably the single most **important** transformer maintenance **test**



## *Insulation Oil Testing* Oil Dielectric Strength Testing

## How is test carried out?

- Typically a 600 ml oil **sample** is taken
- Two special **electrodes** are placed in the oil
- An AC test voltage of typically 0-60kV is applied in a **ramped** fashion at 2kV/second.
- When the oil flashes over the **breakdown voltage** is captured and recorded.
- The oil stands for 2 minutes then the test is **repeated**.
- 6 tests are performed, and an **average** taken
- Most common **standard** is IEC60156
- Don't worry...today's testers allow standard selection and **automatic testing sequences**.



## *Insulation Oil Testing* Oil Dielectric Strength Testing

## Selecting the right set?

- Select the **maximum test voltage**. In most distribution transformers **60kV** is fine but in transmission transformers you may select **80** or **100 kV**
- **Mains** powered for lab or **battery** powered for field testing.
- That is about it!
- These units are **simple** to use but we offer web support and training on the oil sampling and operation of the sets.
- **Frequency**: We recommend you plan to test at least annually and keep the test records to compare earlier tests





**Testing transformer oil therefore is;**

- Essential,
- Easy,
- Affordable.

For more information, ask about our oil testing guide.

Available to PPA members.

## ***Insulation Oil Testing***

### **Oil Dielectric Strength Testing**

The Megger guide  
to insulating oil  
dielectric breakdown  
testing



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Unfortunately, no questions ,  
Please don't hesitate to make  
contact

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