



### The scope

Electrical discharges (ED) in MV power circuits are (1) Partial Discharges (PD) and (2) Partial Arcing (PA). Partial Arcing is a term coined by Martec to explain multiple findings in the field over many years which exhibit some common characteristics of PD.

Most of the switchgear breaker problems experienced are associated with partial discharge or partial arcing activity, causing degradation across the surface of bushings.

- Alignment of breakers must be critically looked at.
- Damaged bushings must be replaced.
- Shutter boxes have to be realigned.



### Misalignment of breakers and shutter boxes may have the following effects:

- Breaker bushings do not align with respective orifice bushings, resulting in an inconsistent electric field around the bushing due to irregular positioning of the shutter box apertures.
- Misaligned shutter boxes may have the same effect as the above.
- Misaligned breakers may also cause the orifice (female) bushing to be damaged, and tracking may occur.
- Misalignment may lead to increased PD action within the cluster.

Voltage stress across insulation depends on the physical geometry and the relative electrical permittivity of the insulation components. Where components of differing permittivity are effectively in series, the stress will be higher across the components with lower permittivity. Gaseous gaps, therefore, tend to experience higher stress than the adjacent solid or liquid insulations.

Small gaps are most susceptible to partial discharge activity. The energy liberated at a partial discharge site will often degrade the insulation. It may form treelike tracks through or over the surface of solid insulation.

The tracks may be conductive, typically because of the presence of carbon from the degradation of the insulation, so that electrical stress is concentrated at the advancing tips of the trees.

The partial discharge may occur in aged, defective or poor quality insulation and can propagate and develop until the insulation is unable to withstand the electrical stress leading to flashover and failure.

**References (AMEU)** - Medium Voltage Switchgear Partial Discharge Investigation by A Rogerson of EA Technology Services

### Female bushing cut open



Note greasy appearance on bushing, this is typical of nitric acid contamination



Electrical discharges appearance on bushing.



Cracks that can turn into failures.

