

PARTIAL DISCHARGE IN INSULATION SYSTEMS

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The effects of Partial Discharge within high voltage cables with solid insulation can be very serious and lead to catastrophic failure of the cable (explosion). The cumulative effect of partial discharges within solid dielectrics results in the formation of numerous, branching discharge channels in a process called treeing. Discharge events cause irreversible mechanical and chemical deterioration of the insulating material. Damage is caused by the energy dissipated by high energy electrons or ions, ultraviolet light from the discharges, ozone attacking the void walls, and cracking as the chemical breakdown processes liberate gases at high pressure.

The chemical transformation of the dielectric also tends to increase the electrical conductivity of the dielectric material surrounding the voids. This increases the electrical stress in the (thus far) unaffected gap region, accelerating the breakdown process.

PENETRATING THE PAPER WINDINGS

In paper-insulated high-voltage cables, the effects of partial discharge are initially shown as small pinholes penetrating the paper windings. As activity progresses, the discharge energy starts to cause chemical changes in the papers and its impregnation. Carbonisation of the papers is common. Once this occurs, a conducting path is formed in that part of the insulation. This generates heat and more charring. Eventually a complete breakdown path exists across the insulation and, unless the current is limited elsewhere, the cable suffers catastrophic damage.


PARTIAL DISCHARGE CAPABILITIES

- On-Line PD testing of HV cables, switchgear and equipment
- On-Line PD mapping of HV cable installations
- Commission testing of HV cables and switchgear
- Measurement of switchgear partial discharge
- Monitoring transformer PD activity
- Testing PD activity of surge arrestors up to MCOV (maximum operating voltage)
- Quality assurance for cable manufacture
- Bushing and insulator testing

PARTIAL DISCHARGE BENEFITS

- On-Line testing means no interruption to electricity supplies
- Enables repairs to be planned and organised before faults occur by identifying problems in advance
- Provides quantitative information to enable maintenance or capital input priorities
- Identifies, monitors and locates intermittent cable insulation faults
- Provides early warning of developing cable and equipment faults
- Ensures new installations are free of electrical defects to provide many years of fault-free service
- Quantifies the risk of failure for critical feeder cables

SUMMARY

In the perfect world, a newly commissioned high voltage cable will be configured and jointed correctly to deliver years of faultless performance. 



A typical fault

CASE STUDY (FROM HVS FILES)

On advice from an insurance risk broker, a well known Australian food processing factory with various processing plants contracted High Voltage Solution.Com to undertake a program of On-Line Partial Discharge Testing to assess all of their high voltage cables and switchgear. The above photo shows one of several serious faults found during the investigation, which, if left undetected, would have caused an unplanned outage, failure or fire.

Not only did the client have a controlled outage to enable repairs to be carried out, but production managers were able to schedule other mechanical jobs into the same period of down time thereby reducing the major cost of an additional outage.

Based upon this experience the client reviewed their factory's maintenance strategy and schedule and now incorporates On-Line Partial Discharge as a regular part of a maintenance program.