Corona and Tracking Conditions in MV Switchgear

"Partial discharge activity has long been accepted as a major cause of failure of medium voltage switchgear..."
[Testing Distribution Switchgear for Partial Discharge in the Laboratory and the Filed", IEEE 2008]

The importance of corona inspection

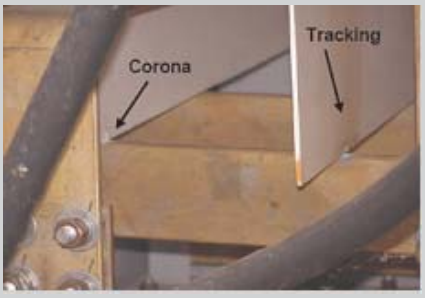
The medium voltage switchgear is the core component of distribution networks, industry plants and power generation, and therefore any internal failure may have a significant impact, mainly because restoration complicated and lengthy.

Surface insulation degradation, especially if triggered by environmental or electrical stresses may become critical in aging equipment. Standard maintenance procedures may not detect it.

Corona activity associated with aging insulation and degradation processes typically increases as the defect propagates. Therefore, corona activity evaluation can be used as a diagnostic tool to assess equipment condition and to locate defect source, enabling selective intervention to remove aging component prior to complete failure.

Once corona becomes active, it leaves behind a conductive "tracking" path on surfaces and also creates a very conductive cloud of air around itself. A flash-over can occur once a tracking pathway is completed from phase to phase or phase to ground.

Electrical discharge in the form of corona and tracking has caused many failures in switchgears with little advanced warning or understanding of the causes. This is especially frustrating for endusers when infrared technology is being utilized as a predictive tool to prevent such occurrences. Corona and tracking conditions are voltage problems that do not produce heat, they go undetected during a typical infrared inspection.



Corona activity advancing to the tracking stage on insulation board resting on 13kV bus. Notice the carbon deposits and light brown discoloration of the insulation board on the right

"Attempting to measure and trend levels of observed ultrasonic activity and trying to relate them to the potential seriousness of surface partial discharge or end of life is not valid and could potentially lead to misleading conclusion" [Testing Distribution Switchgear for Partial Discharge in the Laboratory and the Field", by EA Technology, IEEE2008].

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"Condition assessment of MV substation equipment can play a significant role in supporting asset management decisions and drive maintenance, retrofit or refurbishment actions. On the long run it can help to limit loss of supply events due to equipment failures and relevant personnel safety concerns". [Non intrusive operational MV switchgear condition assessment. CIRED 19th International Conference on Electricity Distribution, May 2007].

What causes corona ?

Geometric factors, spatial factors and environmental conditions are the main reasons for corona formation in switchgear

Geometric factors:

Geometric factors include sharp edges on conductors, connections and switchgear cabinet components. These features can include sharp or squared surfaces on conductors, tag ends on conductors, sloppy tape wraps & corners and other sharp edges on cabinet bracing and support shelves.

Spatial factors:

Spatial factors include small air gap spaces between conductors and switchgear cabinet components.

- Conductors being tie-wrapped together
- Conductors touching insulators, conduit, and edges of cabinets
- Non-shielded cables in contact with grounded surfaces.
- Bus bars in close proximity to insulation board

Environmental factors:

Environmental conditions can greatly affect the presence of corona and tracking. Contamination in the forms of dust, oils/fluids, and other particulates on conductors and insulators will create corona. Also, switchgear rooms that are hot because of poor air circulation and cabinet enclosures that are subject to wet/humid conditions are more likely of have corona and tracking activity over those cabinets that are cool and dry.

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