Avoidance of MV Switchgear Failure, Case Studies of On-Line Condition Monitoring

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Discussion

- Large scale on-line condition monitoring
- Experience of combinations of sensors
- Remote location of discharging assets
- Load, Temperature, Humidity & Pressure
- Defect types
- Time to failure
Large Scale On-Line monitoring

- 60 primary substations 11/33/63/225kV
- 10 distribution substations
- 1000+ switchgear panels monitored
- 1850+ sensors
- 5 years
- SE England (Public & Private)
- France, Hungary, Germany
Avoiding Switchgear Failure

- 1150 substations (33 kV and 11 kV)
- Average of 32 switchgear incidents per year (incidents on 2.7% of substations per annum).
- Effects varied from no interruption in supply to the equivalent of 12 customer years of interruption.
Five Types of Sensors

Capacitive Coupler

Airborne Acoustic

Temperature & Humidity

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Typical Phase Plot

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Location by Transient Voltage Histogram

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Location by Time of Flight

CT Synchro Pairs

7 Day Precedence

Pulse Precedence

Activity over 7 days

T(ch14) minus T(ch13) in 10ns bins

CT Synchro Pairs

7 Day Precedence

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PD, load, temperature, humidity and pressure

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Benefits

• Robust, automated early warnings for timely, targeted interventions before catastrophic failure.
• Identify discharge patterns associated with load and environment conditions at times that may not be picked up by routine manual inspections.
• Provide enhanced safety for those entering substations.
• Enable monitoring of the effectiveness of remedial interventions.
• Prevent loss of supply to customers

One failure on monitored substations in 5 years?
Some Questions

• Experience of combinations of sensors
• How accurate does location need to be
• Effects of Temperature, Humidity & Pressure
• Recognising defect types
• Time to failure