



OFF LINE PD TEST - HV CAPACITIVE COUPLER METHOD

IDENTIFIABLE FAILURE MODES

Partial discharge is seen as a symptom of a failure mode or modes in HV machines. Some of the failure modes that may be identified by Off Line PD testing and or trending are –

- Thermal Ageing / Deterioration / Load Cycling
- Delamination / Inadequate Impregnation or Dipping
- Semi-conductive Coating Failure
- Scarf Joint Failure
- Electrical Tracking /Winding Contamination
- Inadequate Endwinding Spacing

DESCRIPTION

If a motors trend or an individual reading is high the data can be further analyzed to determine the probable cause for the high readings of PD activity. The relationship of the discharge activity to the phase or polarity is important in determining the possible failure mechanism. PD will normally produce both positive and negative pulses thus a positive to negative ratio that can be calculated

Partial discharge may exist within the following areas:

- The main groundwall insulation as a result of delamination or voids caused by missing or incompletely cured bonding material.
- The copper strand/groundwall insulation interface as a result of poor bonding.
- The endwinding region where adjacent coils can have full phase to phase voltage between them and also in the endwinding region as a result of voltage tracking.
- Where the coil exits the slot because the outside of the coil in the end winding is not grounded, it acts like a capacitor with one side not connected. Therefore, it will try to assume the same potential as the copper. A sharp change in potential will exist along the surface of the coil between the portion grounded to the stator core and the ungrounded portion. Stress grading (semiconductive) paints eliminate high potential differences which would cause partial discharge.
- Within the slot, the coil surface is grounded to the stator core with a coating of low-resistance conducting paint or tape. Partial discharge can occur within the slot when contact is lost between the conducting surface



on the coil and the core. This is known as slot discharge. Slot discharge can seriously burn the surface of the coils and the slot fillers.

Partial discharges are often the result of damage caused by other thermal, mechanical, electromagnetic and chemical forces acting on the stator winding. The progressive development of partial discharge activity is the major symptom of insulation deterioration. These discharges also contribute to the aging of the machine's dielectric system by eroding away or deteriorating the insulation system.

In addition to the electrical effects, partial discharge generates ozone in air-cooled motors. Through a series of reactions, nitrogen based acids are formed at dew point from NQ_x . These acids will also attack organic insulations, accelerating the deterioration.

ANALYSIS APPLICATION

HV capacitive coupler method of Off Line PD Testing uses a specifically built HV transformer to induce an ac voltage into the stator windings, the resultant high frequency pulses from 500 pF capacitive couplers are analyzed using a calibrated / tuned circuit by an Adwel PDA premium analyzer.

The tests are carried out on each phase and a final test is carried out on the complete winding.

Information on pulse polarity, repetition rate and the pulse ratio is recorded to give a true indication of the severity of any deterioration and the possible cause of any deterioration.

The analyzer calculates and trends Q_{m+} , Q_{m-} (peak PD activity in the phase that indicates the worst deteriorated area), $NQN+$ and $NQN-$ (the amount of energy due to PD). These figures are tabled with Stator Voltage, Humidity and Winding Temperature when the analysis is performed to determine possible failure modes.

APPLICABLE STANDARD / ACCEPTANCE CRITERIA

The referenced standard for Off Line PD tests is IEEE 1434-2000.

