TechTalk

Introduction MV Motors Partial Discharges

Compiled by John Sherriff | January 2019 | Rev 1

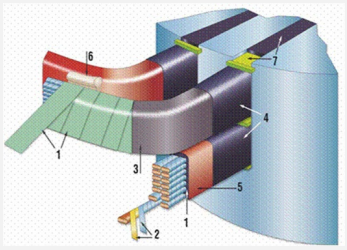
The scope

Surface partial discharges (PD) in stator windings rated 6 kV and above causes bright white deposits on the stator coils, and is usually caused by poorly-made or poorly-applied partly conductive and silicon carbide coatings.

If these surface PD is not attended to, it will lead to high ozone levels within the machine which degrades most metallic and organic components within the motor or generator enclosure. Surface PD in stator windings can be detected using visual inspection and online partial discharge periodic or continuous measurements.

MV / HV Motor Winding Construction

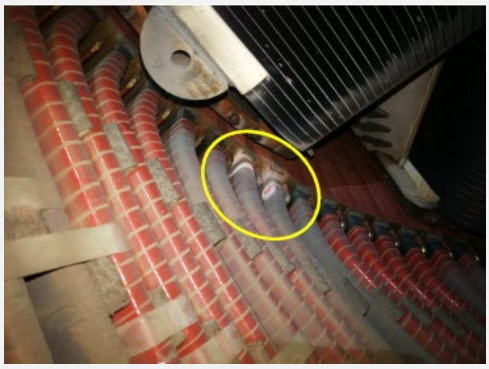
1. Main wall insulation
2. Turn insulation
3. Stress grading
4. Corona shield
5. End-winding sealing tape
6. Bracing material
7. Wedging material



Almost all medium and high voltage motor and generator stator windings rated 6 kV and above have coatings on the surface of the coils or bars to suppress the occurrence of partial discharges (PD) on coils or bars operating at high voltage.

In the stator core slot area of the coil/bar, under the wedges (7) and for a few centimetres outside of it, the coating is usually a graphite-loaded paint or tape that is referred to as the semi-conductive or semi-con coating. It is also called the conductive, outer corona protection or partial discharge suppression coating (Corona Shield 4). The semi-con coating has a surface area resistance of a few hundred to a few thousand ohms per square. This prevents the build-up of any voltage between the surface of the coil and the stator core, and thus prevents surface discharges.

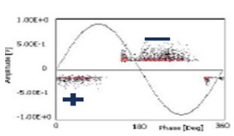
There is a different surface coating that extends from the end of the semi-con coating to about 5 to 20 cm into the end winding area. This coating is often referred to as the stress relief coating (Stress Grading – 3), the end winding corona protection, the semi-conductive coating, or the silicon carbide coating. The purpose of the silicon carbide coating is to linearize the axial electric field at the end of the semi-con coating, which would otherwise be highly non-uniform and thus create PD at the ends of the semi-con coating.



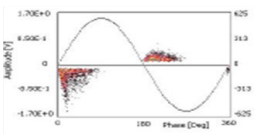
Partial discharge pulses

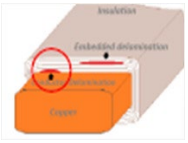
Balanced polarity pulses

Partial Discharge primarily within the insulation main wall. **(Internal delamination or void content).**

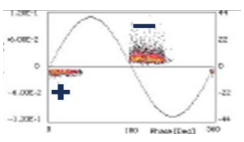


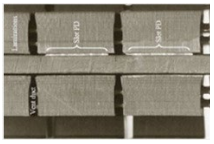
Pulse magnitudes on positive half wave is higher than on negative. Partial Discharge primarily between HV conductor and insulation (Delamination from copper).



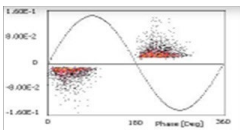


Pulse magnitudes on negative half wave is higher than on positive. Partial Discharge primarily between ground and insulation (Probably slot discharge).

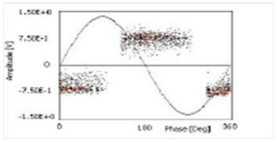


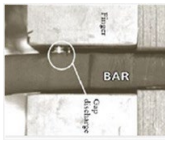


Surface Discharges | The pulse is for outer corona protection when the resistance between the stress grading and slot coating is damaged.



Partial Arcing | The pulse is for discharges between bars and pressure finger in the region where bars/coils leave the iron core.





Between stator bars or different phases and/or between bar and ground in the overhang. These discharges can deteriorate the insulatin system faster than corona.