Frank Messerer 03.12.2001

Gas-Insulated Substation (GIS) for HVDC

Ph.D. Thesis, TU München, 2001, VDI-Verlag

The insulation system of gas-insulated substations (GIS) for HVDC application has been investigated. Two main aspects of DC GIS have been regarded: the field distribution of DC systems is controlled by the conductivity κ of the insulation material and furthermore the problem of surface charge accumulation on solid spacers of the system.

For the investigations experiments with a real GIS setup have been made and in addition to that numerical simulations have been carried out. For the numerical field calculation a complete software tool has been developed that can handle features like volume and surface resistivity, accumulated charges on boundaries, fully charged boundaries and iterativ calculations for non-linear dependences.

The influence of volume and surface resistivity on the field distribution of a GIS spacer has been investigated. The results have proven that a conductive surface coating will improve the field distribution on the GIS spacer. Furthermore such a surface coating should be uniform and independent of the applied field strength. The surface resistivity ρ_{sur} should be in the range of $10^{11} - 10^{12}\,\Omega$. A coating technology suitable for application in service has been found and investigated.

Furthermore, the problem of surface charge accumulation on solid spacer caused by defects has been investigated. This surface charging leads to field distortion. The final steady state of a fully charged spacer can be determined with the numerical field calculation. To investigate the charging mechanism experiments with a GIS setup with installed defects have been made and a software tool has been developed that can simulate the resulting charging process in a GIS. The field distribution on the spacer during and at the end of the charging process can be calculated. The results have shown that uncoated spacers are not reasonably applicable in DC GIS.

By conductive surface coating a current discharge along the spacer can be achieved which prevents surface charge accumulation. A final steady state field distribution is reached, which is independent of possible defects in the GIS. This is a very promising measure to realize a compact insulation system for DC GIS.

Adress of author:

Dipl.-Ing. F. Messerer
Institute of High Voltage Engineering
and Electrical Power Transmission
Technical University Munich
E-Mail: messerer@ei.tum.de