Effect of static mechanical strain on the DC conductivity of extruded cross-linked polyethylene cable insulation

Øystein **HESTAD** (1), Henrik **ENOKSEN** (1), **Sverre HVIDSTEN** (1)

1 SINTEF Energy Research, Trondheim, Norway, oystein.hestad@sintef.no, henrik.enoksen@sintef.no, sverre.hvidsten@sintef.no

Connection of offshore windmills to the grid requires high voltage cables capable to withstand tough environmental and mechanical conditions during service. In particular the dynamic mechanical strain subjected to the cables might accelerate the degradation of the cable insulation. While the main concern is on the mechanical strength of the metallic components, the long-term effect of the mechanical strain on the DC conductivity of the insulation is not known. This is an important parameter when assessing the long-term electrical performance of the cable insulation, especially for HVDC systems.

This article presents DC current measurements performed on a medium voltage cable (95 mm^2 cu conductor, 3.4 mm insulation), where the outer semiconductor was sectioned into two regions by removing two 2x mm wide longitudinal sections of the outer semiconductor. Thus the average conductivity of the insulation material for the two parts of the cable could be measured and compared. To assess the effect of mechanical strain on the conductivity of the insulation of the cable, it was wrapped around a tube with an outer diameter of 110 mm. The cable was wound around the tube carefully ensuring that one section was always compressed (smallest radius), while the other section was always under tension (largest radius). In this way the effect of tension and compression on the conductivity of the insulation could be directly compared. The current through the insulation of the two halves of the cables were then measured at voltages from 8.5 to 65kV corresponding to average fields in the insulation between 2.5 and 19kV/mm. To compare the effect of the static mechanical strain on the measured current the measurements were performed three times. First a reference measurement was performed (before subjecting the cable to mechanical strain), then one measurement immediately after winding the cable around the tube, and finally one measurement was performed after 12 months at room temperature under mechanical strain. All measurements were performed on the same cable at 40°C.

Initial results show no clear effect of the static mechanical strain on the conductivity of the material. The technique developed to measure on longitudinal sections of the cable works well, allowing us to measure on two, three or four longitudinal sections of the cable. In the future similar measurements may be performed on cables subjected to dynamical mechanical strain.