Special Sheath Bonding System for HVAC Cables

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Interpreting the failure statistics for high voltage XLPE-cables in [1], externally caused failures (third party damages) are a decisive factor. A second factor is the number of joints, which can be reduced by enlarging the delivery length of the cables. Combining the both measures, i.e. mechanical protection of the cables (e.g. by tunnels) and enlarging the delivery lengths, allows extreme reductions of the failure rates of high voltage cables. Thus for an enlarged delivery length of 3,000 m and by avoiding external damages, the failure rate of the cable installations with \( U > 220 \text{kV} \) can be reduced by more than 70%.

With enlarged distances between the joints, the problem of enlarged screen voltages arises. A new possibility of doubling the section length for a given limit of the sheath voltage is presented in this paper. This is shown in fig. 1 (only for one phase): a so-called “neutral-path-cable NPC” leads from the earthing points at the ends of the section to its central point, keeping there its zero-potential. There it is connected to a so-called compensation cable (CC), which is laid directly beside the cable core, so that it nearly gets induced the same voltage as the sheath of this core. At one end of the section, this CC is connected to the sheath. By this measure, the potential between sheath and earth does not exceed the sheath voltage corresponding to the half of the section length \( l_0/2 \). The additional expenditure for this installation is on the one hand the NPC-cable, but which is often used, anyway, as an earthing conductor in the cable trench. On the other hand, for each phase a CC-cable must be laid, which should have a cross section as well as an insulation strength similar to the cable sheath.

The paper discusses the layout of the special sheath bonding system with CC and NPC cables. For this, not only the stationary aspects must be discussed. Transient conditions, e.g. the overvoltages during fault situations or overvoltages by travelling waves must be analysed in detail.

Fig. 2 summarises some results of the above mentioned studies to the circuit behaviour, which are executed by means of EMTP. The figure compares the maximum section length between two joints as a function of the permissible sheath a.c. standing voltage, i.e. for normal cross-bonding systems and for the new special bonding system.

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fig. 1:
Installation for doubling the section length between two joints for a given limit of the sheath voltage (here for one phase)
fig. 2: Maximum section length depending on the permissible sheath a.c. standing voltage. Result of one case study on a 400 kV single-circuit siphon system
