

## Development process of extruded HVDC cable systems

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Extruded HVAC cable systems up to 500kV have been successfully developed in the last decades and several years of operating experience are available. Because of an increasing power demand and the requirement to transmit electrical energy over long distances, HVDC cable systems become more important in cable industry and energy grids.

However, due to the DC stress new development activities of extruded HVDC cables and accessories are necessary in terms of design and material for a reliable energy supply in the future. Reasons for this are the strong influence of space charge accumulations in the insulation system, strong dependence of the materials regarding temperature and field strength, and the inversion of field gradient of loaded cable systems. These differences require a special consideration of the components under DC conditions under all possible operation stages regarding temperatures and applied voltages.

After evaluation of the DC influences to the cable and accessories of a HVDC system, a cable system in model scale has been developed and tested. The model scale cable system is based on a 80kV voltage level. General design parameters for the model scale cable system have been taken from well-known HVAC cable systems. However, special materials and design details have to be implemented to withstand the DC specific influences. The tests have been carried out in adaptation to CIGRE recommendations. An adapted type test has been carried out and passed successfully.

After completion of the tests on the model scale cable system, a 150kV HVDC cable system has been developed. Design parameters of the model scale system have been adapted to the 150kV system. Development tests shows the suitability of the designed 150kV HVDC cable system. A type test in adaptation to CIGRE recommendations has been carried out and passed successfully. An internal long-term test is in progress and the successful completion of this test is expected. Further considerations regarding external long-term tests are ongoing. Furthermore, the development of a 320kV HVDC cable system is planned.

This paper addresses the influence of DC stresses on the components of HVDC cable systems. Fundamental aspects regarding the interface between cable and accessory will be discussed. The paper describes the development process of an extruded HVDC cable system from beginning of a prototype system to a commercial HVDC cable system from the view of a cable system manufacturer.