

Qualification of an extruded HVDC cable system at 525kV

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Extruded HVDC cable systems represent a field for which there are high expectations on further development of the technology to enable future cost reduction in power transmission of large power over long distance. Since the first introduction of extruded HVDC cable systems in 1997 the voltage level has increased fast from 80kV to 320kV, and there is no obvious upper limit to the insulation technology. The 320kV level is enabling a transmitted power of about 1000 MW in a bipolar system. During 2014 a new highest level at 525kV for a complete cable system including accessories was launched.

In Jicable 2011 the challenges and opportunities with different insulation material concepts for the cable were described. Cross-linked materials with and without fillers as well as thermoplastic materials were investigated. The solution selected for the 525kV level is based on a newly developed material system combined with an adopted cable manufacturing technology. Experiments have been performed using a variety of test samples ranging from plates to model cables and full-scale cables. A major driving force has been to achieve a higher resistivity of the insulation compound. The non-filled XLPE insulation system implied that well-established procedures for quality control during manufacturing could be used.

The pre-fabricated joint is based on EPDM compounds including a non-linear field-controlling material in order to govern the DC stress. The flexible factory joint for creating long lengths in the factory is as well based on established technology. The terminations are oil-free and instead gas-filled (SF₆) with composite insulators based on earlier developments for HVDC bushings.

The full scale cable system testing is performed according to CIGRE Technical Brochure No. 496. The two main parts in the qualification process are the prequalification (long term) test at 1.45 x 525kV and the shorter type test at 1.85 x 525kV. Two type tests have been performed with successful result as well as a passed one-year pre-qualification test.

The 525kV extruded DC cable system can transmit at least 50% more power over longer distances than the 320kV extruded DC system. The higher voltage level enables the considerably lower cable weight per installed megawatt (MW) of transmission capacity. The transmitted power will reach above 2 GW through one pair of cables depending on conductor area and type.

