

On the way to compare the polarity reversal withstand capability of HVDC Mass-Impregnated and extruded cable systems.

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The reversal of voltage polarity is essential in HVDC cable systems with Current Source Converters (CSC), since it enables to revert the direction of the power flow. Mass Impregnated Non-Draining (MIND) cables are known to be able to withstand the voltage polarity reversal without particular problems. Such ability is assessed by performing a dedicated polarity reversal loading cycle test with voltage polarity reversals every 4 hours, according to Electra 189, 2000. Moreover, since long ago Terna S.p.A., the Italian Transmission System Operator, has introduced in its test protocols for HVDC MIND-insulated cable systems the so-called "sustained polarity reversal loading cycle test". This test has proved to be very effective for a thorough assessment of the cable system performances in the presence of polarity reversal during cable tests of different HVDC interties.

On the other contrary, HVDC cables with extruded insulation are known to suffer the voltage polarity reversal by much, and this unsatisfactory behavior has hampered the development of HVDC-CSC extruded cable systems, with one single realization worldwide to date. As discussed broadly in the literature, the problems for HVDC extruded cable systems under voltage polarity reversal arise from the space charge that is accumulated in the extruded insulation.

However, the latest research and development led some manufacturers to develop HVDC extruded cable systems that are claimed to be capable to withstand polarity reversal. Since the experience is quite scarce, voltage polarity reversal loading cycle tests capable to compare the performances of extruded cables and accessories in the presence of polarity reversal with the known behavior of MIND cables and accessories are required. This paper describes a broad and thorough test campaign that aims at this goal. The campaign is based on a joint partnership between CESI, Terna and a few major cable manufacturers in the world, and is planned to be carried out in the near future in the new HVDC test labs of CESI in Mannheim, Germany. This test campaign has been planned by deriving the voltage levels and duration of the various stages of the tests on the one hand from the experience gained by Terna in testing MIND cables, and on the other hand on dedicated aging and life models developed for extruded cables in cooperation with the University of Bologna, Italy.

Key words

Current Source Converters; Extruded insulation; HVDC cables; Loading cycle tests; MIND insulation; Voltage polarity reversal