

# SUPERIMPOSED IMPULSE VOLTAGE TESTING ON EXTRUDED DC-CABLES ACCORDING TO IEC 62895

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## Content

The European energy supply system is currently undergoing massive changes due to the change from a fossil based to a renewable based power generation. This transition, however, is not only limited to power generation itself but at the same time also affects the whole energy system. In particular, the structure of transmission and distribution grids changes massively and thousands of kilometers of new lines need to be built. This also involves the combination of high voltage alternating current (HVAC) grids with single high voltage direct current (HVDC) point-to-point connections or even an overlay HVDC grid. Whereas HVAC components are well known and established in power transmission and distribution for decades, there is a large development in HVDC components always aiming for higher transmission voltages of currently up to 1100 kV DC. These developments, however, also come with the same requirements on safety and reliability which makes a proper and accurate testing of these components imperative.

One example for such a development as well as the need for accurate testing are cables used for HVDC links. Since cable failures can easily result in down times of years, there is a strong need for an appropriate testing of these cables as well as their accessories. Since extruded cables using crosslinked polyethylene (XLPE) insulations are state of the art for this application, the newly created IEC 62895 (“High Voltage Direct Current (HVDC) power transmission - Cables with extruded insulation and their accessories for rated voltages up to 320 kV for land applications – Test methods and requirements”) defines the testing procedures for such cables. The type and prequalification tests on HVDC cable systems include the superimposed impulse voltage test, during which several switching and lightning impulses are applied on the HVDC cable which has been energized for multiple hours by a DC voltage. The DC voltage shall be maintained during the application of the impulse voltage. This test condition poses a technical challenge to the test setup, since the DC source and the impulse voltage generator have to be protected from each other. Neither must the DC voltage be present at the impulse voltage generator nor must the impulse voltage have any influence on the DC voltage generator. The superimposed impulse voltage test on HVDC cables is a composite test according to IEC 60060-1 Ed. 3.0 which requires suitable coupling and protection elements in combination with suitable converting devices and recording instruments. For the impulse side, the coupling and protection is possible with either a spark gap or a capacitor. For the DC side, the coupling and protection is realized by a damping resistor.

The pros and cons as well as the design aspects of the coupling and protection devices are introduced. A possible smart solution for the capacitive coupling by using spare capacitor stages of the impulse voltage generator is discussed. Additionally, the revision of IEC CD 60230 Ed. 2.0 “Impulse tests on cables and their accessories” is commented with respect to the proposed test setups and the measuring system for the superimposed impulse voltage test.

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